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Survey of productivity rates used for highway construction.

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SURVEY OF PRODUCTIVITY RATES
USED FOR HIGHWAY CONSTRUCTION

by

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To Susan, for her enduring support and patience.

ABSTRACT

The ~~primary~~ purpose of this paper was to report on a survey conducted by the University of Florida for the Florida Department of Transportation (FDOT). The survey analyzed the productivity rates used by the FDOT to determine contract duration with respect to highway construction contracts. The survey also reported on some of the factors that affect productivity.

A questionnaire was sent to each FDOT Resident Engineer to survey the current productivity rates that are being achieved by contractors. The contractor productivity rates where then compared to the current productivity rates used by the FDOT, and recommended changes are offered.

Also included in this paper are discussions concerning the importance of productivity in the construction industry, and the importance of using productivity to estimate contract duration and construction costs.

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CHAPTER 1

INTRODUCTION

A. Background.

Construction is the worlds largest and one of the most challenging industries. In the United States the construction industry is the largest industry in terms of dollar volume, number of persons employed, and contributions to the gross national product (GNP). The construction industry employees over 10% of the work force and contributes over 10% of the GNP. This 300 billion dollar-plus industry is highly fragmented and diversified with the contractors ranging from a few giants who employ thousands of people to the majority of contractors that employ less than 10 employees.[1] Productivity plays an important role in the construction industry. An increase or decrease in productivity affects every aspect of our daily lives. Productivity contributes to our standard of living, the nation's economy, and sets the direction of our future.

B. Objective.

The objective of this report is two fold. First, productivity will be discussed in general terms with respect to the construction industry. Productivity will be defined, and attention will be given towards the importance of using productivity to determine contract duration and estimating contract costs on construction contracts. The second objective of this report will be a case study which reports on a University of Florida Survey conducted for the Florida Department of Transportation (FDOT). The study surveyed the productivity rates used by the FDOT to determine contract duration with respect to highway construction contracts. An analysis of this data will be conducted, and recommendations will be provided to assist the FDOT with determining contract time on highway construction contracts.

C. History.

The analysis and concern of construction productivity in the late 20th century is nothing new. The survival of early civilizations depended on how effective it obtained and used its resources. From 4000 to 100 B. C. architecture and construction flourished. Great temples were built in Sumer, Pyramids were built in Egypt, and the Greek Pantheon was built in Greece. The construction of the pyramids were some of the greatest structures ever constructed. It is not known how the pyramids were constructed, but it has been reported that 100,000 workers were used. It required planning, organizing, and controlling of the manpower and available resources to build structures of this magnitude. The development of management skills and the technique of keeping a written record were essential for the construction of these early structures.

The management invented by the Sumerians and Egyptians, and refined by the Greeks was further developed by the Romans with the use of job descriptions and specifications. The job descriptions allowed for the division of labor which created experienced and more efficient laborers.

The next major advancement in construction productivity came at the beginning of the industrial revolution with the invention of the mechanical clock. These clocks were used for time studies. Time studies were not new; however, without an accurate method for measuring time it was hard to compare and develop a time study that had any significance. Throughout the industrial revolution management techniques improved and time studies advanced. Some early pioneers in productivity measurement and improvement are Fredrich Taylor from the late 1800's, and Frank Gilbreth, who in 1909 published a book of bricklaying systems. Gilbreth pioneered the application of motion study to increase productivity in the construction industry. Also during this time period Henry Gantt made four major contributions to scientific management which had a major affect on the construction industry. They are:

1. The well known Gantt Bar chart,
2. A task and bonus plan that guaranteed a daily wage for output less than standard,
3. A policy of instructing workers rather than driving them. This policy was presented in 1908 and was clearly ahead of its time. It was not until after World War I that management accepted that training of workers was their responsibility,
4. Introduction of the concept of industrial responsibility, with service as the ultimate goal rather than profit.2

In more recent times the development of the computer has enabled managers to schedule contracts and track productivity data more efficiently. The computer allows construction companies to integrate the estimating, scheduling, and cost control functions of their businesses.3 Often, and particularly in larger firms, the individuals assigned to these three tasks do not communicate with each other. This independence results in duplication of effort, lack of coordination, and a negative effect on overall productivity. The three functions are closely related and work most productively as a system. The computer has also made scheduling complicated projects easier with the computer programs that are available to construction companies. Probably the most common use of the computer is for tracking cost control functions. These functions include:4

1. Faster and easier accounting audits,
2. More accurate information about job costs, equipment costs, cash flow, etc.,
3. Accurate job-site and company operating information,
4. Quicker and more economical preparation of required reports, W-2's,etc.,
5. Efficient month-end, and year-end closing information.
6. Special reports and analysis on request.

The computer provides the construction manager with up to date productivity data. This quick access to information allows the manager to make prompt decisions hopefully affecting productivity in a positive way.

D. <u>Decline of Productivity</u>.

Most of the productivity studies in the early 20th century were conducted on construction activities; however, it seems that the results of the studies have been more successfully applied to the manufacturing industry. From 1909 to 1952, manufacturing productivity per man-hour increased 2.6 times faster than construction productivity.

From 1960 to 1973 the rise in industrial productivity in the United States was 3.3 percent while other countries had double or more the annual rate of the U.S. increase. In the last 10 years the industrial productivity has dipped even lower and has maintained only a 2.7 percent annual increase. The increases in construction productivity is even lower. It has been increasing at a rate of less than 1.0 percent a year. The construction industry has been consistently rated the worst in terms of increased productivity.

In 1986 the U.S. Department of Commerce published a list of productivity increases for various industries (figure 1.1). This data shows just how low the construction productivity increases are compared to other industries.

INDUSTRY	PRODUCTIVITY INCREASE %
Agriculture	3.64
Construction	0.80
Government	1.64
Manufacturing	2.60
Mining	3.17
Public Utilities	5.40
Transportation	4.60

Figure 1.1 1986 Productivity Increases For Various U.S. Industries. (Adrian, 1987)

There are numerous theories as to why construction productivity has lagged or failed to rise when compared to other industries. One theory suggest that the lack of increase in construction productivity is due to the increasing complexity of the construction industry.5 More complex and larger projects exist now than in the past. The projects have incorporated sophisticated technology in materials and equipment, but little attention has been given to installation procedures. The projects are increasing is size which is decreasing the expected productivity rates and increasing the project duration and construction costs. The cost of construction has risen at a rate approximately 50 percent higher than the inflation rate. The author continues to state that construction has progressed through the evolutionary stage of master builders to the point that the construction industry consists of specialists. A given project can be dependent on over 20 participants (figure 1.2). With this increased complexity it has been estimated that of some projects as little as 20 percent of the theoretical man-hours are used in actually putting work in place.6

Another theory for the low productivity in the construction industry sites that excessive nonproductive time of 45 percent is found on a typical construction project.7 Every industry has nonproductive time, but it is felt that the uniqueness

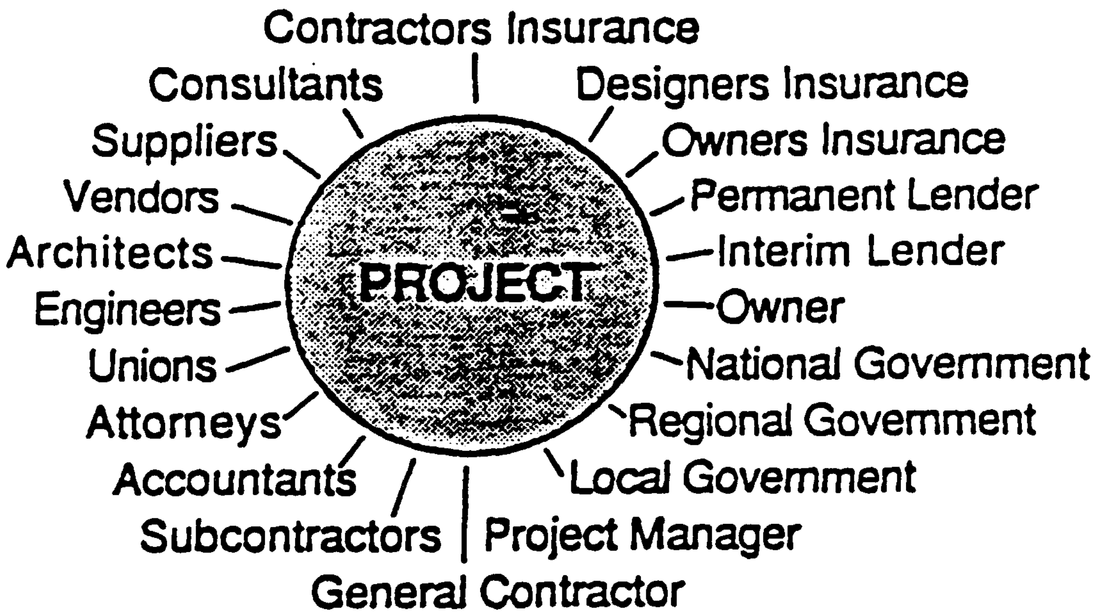

Figure 1.2 Project Participants.

of the construction industry contributes to a higher percentage of nonproductive time than occurs in most industries. The construction industry is different than other industries; because each project is unique, it is geographically dispersed, and it occurs in a changing physical environment. This nonproductive time can be broken down into three broad categories. Approximately one-third of all nonproductive time can be traced to industry-related factors, another third to labor-related factors, and a final third to management factors.8 A detailed listing of these factors is contained in figure 1.3.

Industry-related factors	*Labor-related factors*	*Management-related factors*
Uniqueness of many projects	High percentage of labor cost	Poor cost systems and control
Locations at which projects are built	Variability of labor productivity	Poor project planning
Adverse weather and climate seasonality	Supply-demand characteristics of industry	Poor planning for measuring and predicting productivity
Dependence on the economy	Little potential for labor learning	
Small size of firms	Risk of worker accidents	
Lack of R & D	Union work rules	
Restrictive building codes	Low worker motivation	
Government labor and environmental laws		

Figure 1.3 Reasons For Nonproductive Time In The Construction Industry

A third theory states that the three most prominent factors causing decreased productivity are:9

1. Excessive governmental regulations,
2. Inadequate investment,
3. Reduced research and development.

These are just a few of the theories that are used to explain and justify why the construction industry's productivity rate has not kept pace with other industries. All of the theories have merit, and there does not seem to be one simple solution to the problem.

E. <u>Definition of Productivity</u>.

How do you define productivity? What does productivity mean to your employees? At what level of productivity does your organization operate? What standards are used to measure productivity? Does your organization have have productivity goals to meet or a program to monitor productivity? How do your employees react to the productivity goals?

The answers to these questions vary depending on how well the organization is tuned into the importance of productivity and its measurement. Some employers simply can not answer the questions. A high level of productivity is important to any company's success and survival. There is no common widely shared industry definition of productivity, and there is no best way to measure the fluctuation of productivity.

There are many definitions used to define productivity. The term productivity is generally used to denote a relationship between output and the associated inputs used in the production process. The simplest definition of productivity is the ratio of outputs of goods or services to inputs of resources.10 The common expression of productivity is shown as follows:

PRODUCTIVITY = OUTPUT/INPUT

The ratio can be quantified in many different ways. A partial productivity ratio only quantifies one input factor per output; for example, output per man-hour. A complete ratio of productivity would include all the input factors required to produce the output. These input factors include items such as; labor, material, capital, energy, equipment and design. Because of the complexities involved with measuring and identifying representative factors, the use of partial productivity ratios is more common. It is therefore important when comparing productivity rates to specify which input and output factors will be measured. One must understand the productivity ratio's application and limitation.

In the construction industry the most common way to quantity productivity is to relate the output to the quantity of labor required to produce the output. The labor is usually measured in man-hours or dollars. An example of this partial productivity ratio would be tons/man-hour or cubic yards/man-hour.

Where the construction industry usually uses quantity of labor for measuring productivity , other industries use other factors in their definitions. One of the most broad and universal definitions is used by the United States Department of Commerce. They define productivity as dollars of output per man-hour of labor input. Using this definition the Department of Commerce reports annually on the United States productivity. When using the Department of Commerce's definition to compare productivity over a period of several years it is necessary to adjust the numerator (dollars of output) for inflation and other factors that would affect the value of output. This adjustment will allow for the productivity ratios to be compared in constant dollars.

F. Related Productivity Terms.

There are many different but related terms that are used in conjunction with productivity. What do we mean by productivity in terms with performance, production, and efficiency?

Productivity is not the same as performance. A worker can work strenuously but have low productivity due to ineffective working methods. On the other hand, productivity can be high with low performance with the assistance of automated equipment. Performance is usually regarded as the product of the worker's ability and motivation. An employee's performance can rise or fall with an increase or decrease of motivation or ability.

Sometimes productivity is regarded synonymous with production. Production is the process of transforming inputs (labor, material, capital, energy, and equipment) into a good or service such as a road or building. Total production may increase by increasing an input factor; however, productivity can remain constant or change if the ratio of output to input changes. An example of production increasing while productivity remains constant would be: 4 units per 2 man-hours, compared to 12 units per 6 man-hours. The input has increased, but the productivity has remained the same. It in important to specify the input and output to be measured when comparing productivities.

Efficiency is simply the ratio of actual productivity divided by the estimated productivity. The main use of efficiency is in comparing productivities of different factors or of the same factors at different times. This ratio allows the project manager to compare the estimated productivity with the actual productivity.

CHAPTER 2

USING PRODUCTIVITY

A. Measuring Productivity.

Productivity standards provide the basis for comparing current productivity rates, and the estimation of the costs and duration of a proposed project. The main methods used in the construction industry to develop and measure productivity standards are by using historical accounting data, or by analyzing a work process and then developing a scientific standard.11 The accounting based standard is the most popular and usually the most reliable for contractors.

Historically Based Standard.

The accounting based standard is based on historical data that has been collected from past projects using the contractor's cost control system. The process for developing and collecting the data is relatively simple, and the historical measurements of productivity can be invaluable if used and stored correctly. [illegible] is easy to see that the more historical productivity data that is collected on an event, the more the contractor can rely of his estimate or schedule.

There are four potential weaknesses that characterize the use and collection of historical data.12 I feel that these weaknesses can be over come as long as the personnel utilizing the data are aware of how and under what conditions the data was collected.

The first potential weakness is that construction contractors never build the same project under the same working conditions using the same resources. A few of these changed conditions include weather, number of men, and quality of management. Continuous collection of data can average these conditions, and make the data reliable to predict future events.

A second criticism is that the historical data may not be current. It does take time to collect and process the data; however, the construction productivity has been relatively unchanged over the past ten years. This really should not be a major concern.

A third problem cited relates to the difficulty of obtaining accurate accounting data at the job site. For most jobs the foreman and superintendents tend to discount the need for accurate accounting data. It is therefore necessary to develop a reliable and mandatory job site accounting system.

The fourth problem with collecting and using historical production data is that the productivity inefficiencies are included in the data. Accounting records do not differentiate between productive and nonproductive time. The records represent what has been done rather than the potential of what could be accomplished. This is not all that bad though, because if the contractor can not over come some of these inefficiencies they should remain part of the production rate; otherwise, the contractor's estimate will be to low which could result in financial loss.

Scientifically Based Standard.

As mentioned earlier the second method for measuring and setting productivity standards is by analyzing the work process and then developing a scientifically based standard. There are many techniques that are used to develop these standards. One process is the work study method.

A basic knowledge of probability statistics is very useful for the use of the work study method. Much of the data collected is subject to variability and cannot be determined to be correct with absolute certainty. The work study is divided into two parts, method study and work measurement.13 Method study is mainly concerned with the reduction of unnecessary work content and the ineffective time associated with it. Work measurement techniques provide a means for measuring times of work operations. The work study technique consists of randomly measuring and observing a portion or sample of a work crew. After making the observations new ways are proposed to improve the productivity of the job.

The work study is actually very systematic. Each portion of a work task is investigated in detail to ensure that no factor affecting the efficiency of an operation is overlooked. The detailed study covers site layout, labor, equipment, tools, and materials handling procedures.14 The evaluation should begin from the overall or big-picture viewpoint and progressively focus of the smaller elements of the task. Unless the relevance of the small task is understood in the context as a whole, effort is often wasted on details that are not relevant.

The construction work is broken down into elements, both productive and nonproductive so that the observer is certain to record and time each element accurately. When conducting a work study the observer should remember that the contractor's needs are paramount. The work study design needs to be flexible enough for the observer to respond to the changing conditions of the job site. A work study procedure should adhere to the following basic steps:15

1. Select the work to be studied,
2. Record all relevant facts,
3. Examine the facts critically,
4. Develop the new method,

5. Install as standard practice,

6. Maintain by routine checks.

There are many other techniques that are used to develop scientifically based productivity standards. Some of these methods are work sampling, motion analysis, and time study.

B. Estimating.

The importance of accurate productivity information cannot be over looked. Whether you gather and calculate your own information or use one of the many published books that contain productivity rates. Knowing accurately the productivity rates of ones own resources is the key to good estimating, and good estimating is the key to success in the construction industry.16

The preparation of accurate estimates leads to the success or failure of the construction project that is being bid upon. An estimate to low will insure financial loss, and an estimate to high will price the construction company out of a job. Much time and money is spent to prepare a bid or estimate, and the accuracy of the bid or estimate is dependent on the accuracy of the productivity rates. There are many elements that are vital to an accurate estimate. The three most prominent elements are:

1. Determine the quantity of work and material,

2. Identify the productivity rates to be used,

3. Calculate the unit cost of the resources.

Of these three productivity is the element most subject to uncertainty. Given the wide variation in the productivity of the resources that are part of the construction production process, the forecasting or estimating of productivity rates is undoubtedly the leading risk factor in a construction estimate. The estimators get their information for productivity rates from numerous sources which include field experience, books, and historical records.

To estimate direct labor cost of a project an estimator can use productivity rates in the form of man-hours per unit or dollars per unit. For example, for the direct labor cost of carpenters placing a form for a concrete wall, the estimator might establish a historical productivity data file of 12 man-hours per 100 square feet of forms, or a unit cost of \$1.44 per square foot of form. These two types of productivity data can be changed from one to the other as long as the labor wage rate is known. To continue with the example, assume that through historical information it has been determined that it takes 12 hours of carpenter labor to place 100 square feet of form for a concrete wall. It is also known that the labor rate for a carpenter is \$12 per hour. Therefore:

$$\text{Unit Cost} = (12\text{ hr})(\$12/\text{hr})/(100\text{ sf}) = \$1.44/\text{sf}$$

Care should be taken when using any historical data for estimating. The man-hours per unit productivity rate is not as sensitive to change over time as unit cost data are. From 1970 to 1980 direct labor productivity was relatively constant and averaged less than a 1 percent annual increase. During this same time period, construction wage rates increased by as much as 15 percent in a single year.[17] As can be seen, the estimator must know what the historical data is based on and how old the data is that is being relied upon.

If no historic data is available there are many references that can be utilized that publish productivity rates and costs for various items. These references normally give a national price per unit that must be modified for your particular geographic area. Some of the more popular references are:

1. R. S. Means Building Construction Cost Data,
2. Dodge Construction Pricing & Scheduling Manual,
3. Richardson General Construction Estimating Standards,
4. F. R. Walker's The Building Estimator's Reference Book.

Productivity of construction resources to include labor and equipment is dependent of numerous factors, including weather, job location, and supervision. These are only a few of the factors that the estimator has to deal with. It is the estimator's ability to identify the many factors that impact productivity that dictates the accuracy of a construction estimate. Clearly the estimator's understanding of productivity including its forecasting and measuring enhances a contractor's ability to improve his performance. When more standardized productivity information is available to the estimator less time and money is needed to prepare the estimate. More importantly though, the degree of accuracy of the estimate, and the estimator's confidence level goes up as more productivity information becomes available.

C. Scheduling.

Much information can be found concerning the scheduling of construction projects; however, there is not much information that relates the importance of the relationship between productivity and scheduling. A project schedule has a great deal in common with the cost estimate, both are made before the start of the contract and both are based on historical productivity data. Most of the information relating productivity and estimating already stated in this report is equally applicable to scheduling and will not be repeated here.

A project schedule is made by dividing the project into work activities of project components. The task of breaking the contract into project activities requires special attention, sense the resulting list of project activities dictates the overall project plan and schedule. There are many methods available that are used to combine the activities together to form a complete project schedule and determine the contract duration. Some of the more popular scheduling techniques are the Bar Chart, the Critical Path Method (CPM), and the Line of Balance (LOB).

The scheduling techniques are different in many ways; however they all have one characteristic in common. They all use productivity rates to determine each activity duration. The productivity rates used must be in the form of a unit quantity per unit time. Productivity rates in the form of dollar per unit quantity cannot be used to determine activity durations.

Each activity duration is determined on the basis of the quantity of work, the crew to be assigned to the work, and the crew's productivity.18 The following is an example of determining activity duration for placing wall forms.

Quantity of work	8000 sf
Estimated productivity	10 mh/100 sf
Crew size	5 workers

Duration = (8000 sf)(10 mh)/(100 sf)(5 mh/hr)(8hr/day)

= 20 Days

Each activity productivity is dependent of the contractor's resources that he chooses to use to perform the activity. These resources include labor, equipment, material, and capital.19 The contractor must choose the best combination of these resources to maximize the activity productivity.

Like cost estimating, determining activity durations is subject to uncertainty and contains a degree of risk. It is important for the owner or the architect-engineering firm who decides the overall contract time to make this duration realistic and obtainable. Tight schedules foster low productivity as progress becomes more important than efficiency.

CHAPTER 3

UNIVERSITY OF FLORIDA SURVEY OF FLORIDA DEPARTMENT OF TRANSPORTATION PRODUCTIVITY RATES

A. Introduction.

The Florida Department of Transportation (FDOT) uses standard productivity rates to determine contract time for their highway construction contracts. These productivity rates are based on a study conducted by the FDOT in 1959. In today's contracting claimant the use of current and accurate productivity rates is paramount.

The determination of contract duration has gained added significance due to disputes between the contractors and the FDOT which has led to legal action in many cases.20 In some cases the contractor has alleged that the contract times established by the FDOT were unreasonable. Because of the age of the standard productivity rates and the heightened awareness brought about from the disputes by contractors, the FDOT wanted to update their productivity rates and review their method for determining contract time.

The FDOT contracted with the Civil Engineering Department of the University of Florida to review the

FDOT procedures for setting contract time. Part of this review included updating the standard productivity rates used by the FDOT. This report will not discuss in detail how the standard productivity rates are used to predict contract time; however, this report will analyze the productivity survey that was sent to all the FDOT Resident Engineers, and compare these rates to other productivity rates being used by other state highway agencies and contractors.

The current FDOT procedure used to determine contract duration is based on standard productivity rates and the total quantity of work for specific work activities. The number of working days per activity is calculated by dividing the total work quantity by its corresponding productivity rate. The total contract duration is then determined by adding the number of working days allotted to each activity. Work days are then converted to calendar days by multiplying by a conversion factor of 1.43.

B. <u>The UF Survey</u>.

A survey questionnaire was prepared and sent to all FDOT Resident Engineers to collect daily productivity data on 17 of the standard productivity rates that the FDOT uses to determine contract time. A sample of the survey questionnaire is contained in Appendix A. A sample of the Project General

Information sheet and a Field Observation Work Activity sheet from the survey follows as figure 3.1a and 3.1b. Ralph Ellis, a research assistant at the University of Florida, designed the survey form and sent the survey to the Resident Engineers. The response to the survey was outstanding with only one Resident Engineer not responding. Each Resident Engineer was asked to select three projects and record the contractor productivity for the 17 work items included in the survey. Five separate measurements of total daily productivity were requested for each activity. Not only were the engineers requested to record daily productivity data, they also recorded factors that might affect the productivity of the work activity.

Figure 3.1a shows the information that was recorded for each project observed, and figure 3.1b shows an example of the factors that were recorded for each work activity. The 17 work activities that were studied. They are:

Milling Existing Pavement		Clearing & Grubbing
Reflective Pavement Markers		Base Construction
Breaking & Compacting Concrete		Sidewalk
Compression Seal Replacement		Concrete Pavement
Surface Treatment	Guardrail	Excavation
Plant Mix Surface	Stabilizing	Seed & Mulch
Curb & Gutter	Storm Sewers	Sod

COLLEGE
OF
ENGINEERING

UNIVERSITY OF FLORIDA

GAINESVILLE, FLORIDA 32611
AREA CODE 904 PHONE 392-0933

DEPARTMENT OF CIVIL ENGINEERING

SPECIAL RESEARCH PROJECT
for
FLORIDA DEPARTMENT OF TRANSPORTATION

PROJECT GENERAL INFORMATION
(Please, see instructions on reverse side.)

1. PROJECT TITLE: ______________________________
2. STATE PROJECT JOB NO.: ____________________
3. TOTAL CONTRACT PRICE OF THE JOB: $ ______________
4. THIS PROJECT WOULD BE CATEGORIZED AS:

   ___ RECONSTRUCTION OF AN EXISTING ROAD
   ___ CONSTRUCTION OF A NEW ROAD
   ___ IMPROVEMENTS TO AN INTERSECTION
   ___ SIGNALIZATION
   ___ BRIDGE

   OTHER ______________________________

5. THIS PROJECT IS LOCATED IN ______________ COUNTY.
6. LOCAL CONDITIONS:

   ___ RURAL
   ___ URBAN
   ___ LIMITED ACCESS ROAD (INTERSTATE)

7. TRAFFIC CONDITIONS:

   ___ LIGHT
   ___ MEDIUM
   ___ HEAVY

8. FDOT RESIDENT ENGINEER ____________________ DATE: __________

Figure 3.1a Project General Information Sheet

COLLEGE
OF
ENGINEERING

UNIVERSITY OF FLORIDA

GAINESVILLE, FLORIDA 32611
AREA CODE 904 PHONE 392-0933

DEPARTMENT OF CIVIL ENGINEERING

SPECIAL RESEARCH PROJECT
for
FLORIDA DEPARTMENT OF TRANSPORTATION

FIELD OBSERVATIONS
(Please, see instructions on reverse side.)

WORK ACTIVITY: **CLEARING and GRUBBING**

1. STATE PROJECT JOB NO.: ______________________

2. TOTAL QUANTITY OF WORK IN THE JOB: __________ acres

3. OBSERVED PRODUCTION QUANTITIES:

DATE: __________ QUANTITY: __________ acres NO. HOURS WORKED: __________
DATE: __________ QUANTITY: __________ acres NO. HOURS WORKED: __________
DATE: __________ QUANTITY: __________ acres NO. HOURS WORKED: __________
DATE: __________ QUANTITY: __________ acres NO. HOURS WORKED: __________
DATE: __________ QUANTITY: __________ acres NO. HOURS WORKED: __________

4. TYPE OF CLEARING AND GRUBBING WORK:

___ light : grass and scattered brush
___ medium : brush and scattered trees
___ heavy : heavy brush and large trees

5. FACTORS WHICH HAD AN EFFECT ON PRODUCTION:

___ WEATHER (RAIN)
___ TRAFFIC
___ INSUFFICIENT MANPOWER OR EQUIPMENT
___ UTILITY DELAYS
___ PHASING OF WORK REQUIRED BY CONTRACT
___ BURNING NOT ALLOWED
___ OTHER ______________________
___ OTHER ______________________

Figure 3.1b Sample, Work Activity Sheet

The survey measured the daily productivity rate for each work activity. Since the FDOT does not know the contractor's capability of the resources that will be used to complete a contract, the measurements taken for the survey do not take into account the crew size or the number of hours worked by each crew. These two items are critical when trying to determine productivity rates; however, the FDOT must measure the daily productivity rate independent of these critical items.

C. <u>Productivity Factors Used In The UF Survey</u>.

My task was to analyze the questionnaires that were completed and returned to Ralph Ellis, and provide an average productivity rate for each work activity, and also determine the effect that the different productivity factors had on the work activities. The questionnaires were transferred to a Lotus 123 spreadsheet so they could be manipulated. There were 60 construction projects that were transferred to the spreadsheet.

For each project the engineer was required to determine three different conditions or group of factors that could affect the productivity of the entire project. See figure 3.1a. The first condition was the category of the construction. These categories are: reconstruction of an existing road; construction of a new road; signalization; and bridge. The second condition was the local conditions of rural, urban, and limited access road (interstate). The third condition was traffic conditions of light, medium, and heavy.

Each work activity also had factors that could have an effect on productivity. These factors were weather, traffic, insufficient manpower or equipment, utility delays, and phasing of work required by the contract. See figure 3.1b. Some of the work activities had more factors depending on the nature of the work. These are not all of the factors that can effect productivity, but it was felt that these were the ones that could be easily identified by the Resident Engineers.

An average productivity rate was calculated for each work activity. Each data sample was then categorized by productivity factor, and then analyzed to determine the positive or negative effect that the productivity factor had when compared to the overall productivity rate for the work activity.

D. Analysis Of UF Survey Results.

As stated before, the participation in the survey by FDOT Resident Engineers was outstanding. A total of 60 construction projects ware surveyed, and a total of 1354 observations were measured. These observations are spread over the 17 major work activities.

A brief summary of the average productivity rates obtained in the survey for each work activity is contained in table 3.1. For comparison purposes the productivity rates that are currently being used by the FDOT are shown in table 3.2. Tables 3.3 through 3.19 contain the summary for each work activity, and are located immediately following this section. These tables also show the effect the factors had on productivity. Of all the data collected only one observation appears to be way out of line. This was the 69,672 SY/DAY observed for stabilizing. This value is 3.5 times greater than any other observation for this work activity and even 15 times higher than the recommended rate of 4,500 SY/DAY.

There were no real surprises in the results. The factors contained on the project general information sheet (figure 3.1a) effected the productivity rates as expected. The productivity rates associated with construction were higher than those associated with reconstruction. Likewise, the productivity rates

SUMMARY OF PRODUCTIVITY RATES
UNIVERSITY OF FLORIDA SURVEY

	WORK ACTIVITY	AVERAGE	NUMBER OF SAMPLES	DAILY HIGH	DAILY LOW
1.	CLEARING & GRUBBING	2.29 ACRES/DAY	106	11.19	0.018
2.	EXCAVATION	1,044 CY/DAY	122	12,451	7
3.	STABILIZING	4,636 SY/DAY	78	69,672	62
4.	BASE CONSTRUCTION	1,691 SY/DAY	160	10,923	14
5.	SURFACT TREATMENT	653 CY/DAY	22	2,239	35
6.	CONCRETE PAVEMENT	82 SY/DAY	15	136	8
7.	MILLING EXISTING PAVEMENT	12,244 SY/DAY	95	32,028	444
8.	PLANT MIX SURFACE	720 TONS/DAY	198	2,863	6
9.	STORM SEWERS	68 LF/DAY	108	400	3
10.	CURB & GUTTER	335 LF/DAY	93	1,402	0
11.	SIDEWALK	130 SY/DAY	35	957	2
12.	SEED & MULCH	23,577 SY/DAY	58	118,287	1,300
13.	SOD	1,799 SY/DAY	139	16,536	6
14.	GUARDRAIL	365 LF/DAY	52	2,288	0
15.	REFLECTIVE PAVEMENT MARKERS	626 EACH/DAY	57	2,215	36
16.	BREAKING & COMPACTING CONCRETE	90 SY/DAY	10	228	5
17.	COMPRESSION SEAL REPLACEMENT	141 LF/DAY	3	186	114

Table 3.1 Summary of Productivity Rates
University of Florida Survey

FDOT PRODUCTION RATE FOR ESTIMATING

WORKING DAYS

No.	Work Description	Number of Working Days
1.	Clearing and Grubbing. 000023 Ac./SF	1 to 10 Acres per day,
2.	Excavation (Regular, Lat. Ditch, Subsoil; Convert grading roadway to Cu. Yds. for this purpose). Shldr. grading (Resurfacing) at 1 mi/day	(See chart for No. Days)
3.	Stabilized Roadbed	5,000 Sq. Yds. per day (Not to exceed 10 days)
4.	Bases (Sand-Clay; Limerock; Limerock Stabilized, Shell Stabilized; and Soil Cement Base)	(See chart for No. Days)
5.	Surface Treatment	200 Cu. Yds. per day
6.	Cement Concrete	5,000 Sq. Yds. per day
7.	Milling Existing Pavement	4,000 Sq. Yds. per day (Max 20 days)
8.	Plant mixed surfaces (in tons- for conversion see * below)	(See chart for No. Days)
9.	Storm Sewers (on Munic. Const.; includes pipe, inlets, manholes, etc.)	100 to 400 linear ft. per day
10.	Curb and Gutter, Valley Gutter, etc.	300 to 700 linear ft. per day
11.	Sidewalk	300 Sq. Yds. per day
12.	Sprigging/Grassing 2420 S	15,000 Sq. Yds. per day (Not to exceed 15 days) (225,000)
13.	Guardrail (When a significant part of Contract)	1,500 linear ft. per day
14.	Breaking & Compacting Exist. Conc. Pav't (RE-SEAT CONCRETE PAVEMENT)	5,000 Sq. Yds. per day

Table 3.2 Current FDOT Productivity Rates

15.	Utility Delays	(Consider complexity and type Construction)
16.	Compression Seal Replacement	30 ft. to 40 ft. per day (Use 40 ft. for 2,000 ft. +)
17.	Reflective Pavement Markers (When a significant part of Contract)	0 - 20,000/500 per day 20,001 - Up/1,000 per day
18.	Bridges	(Use charts)
19.	Small Bridges and Drainage Structures (No extra time unless they comprise a substantial part of the work and would require extra time)	
20.	General Time: (Moving in preparatory to commencing work, etc.)	(15 days Normal, 25 Days Resurfacing)
21.	Special Acquisition Period allowed Prior to beginning charging of Contract Time (Calendar Days)	
	a. Resurfacing (not when primarily recycling)	1 - 20,000 Tons/30 days 20,001 - 60,000 Tons/60 days 60,001 - Over Tons/90 days
	b. Signalization (when primary work is signalization). Reconsider on jobs when "other work" exceeds 90 days, in which case the period may be shortened.	90 days
	c. Highway Lighting (when primary work is lighting). Reconsider on jobs when "other work" exceeds 120 days, in which case the period may be shortened.	120 days
	d. Highway Lighting Conversion (Mercury vapor to high pressure sodium)	90 days

Table 3.2 cont.

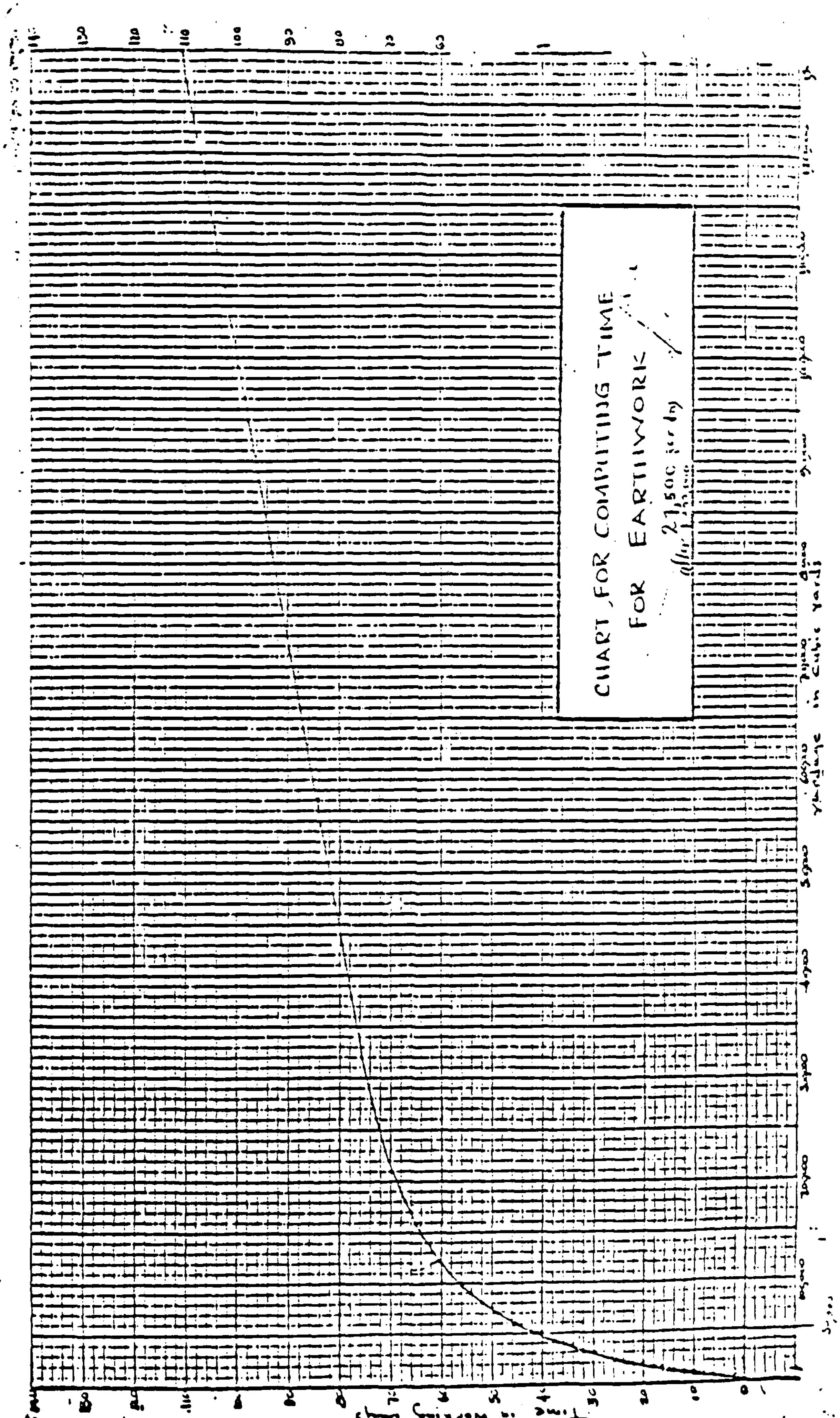

Table 3.2 cont.

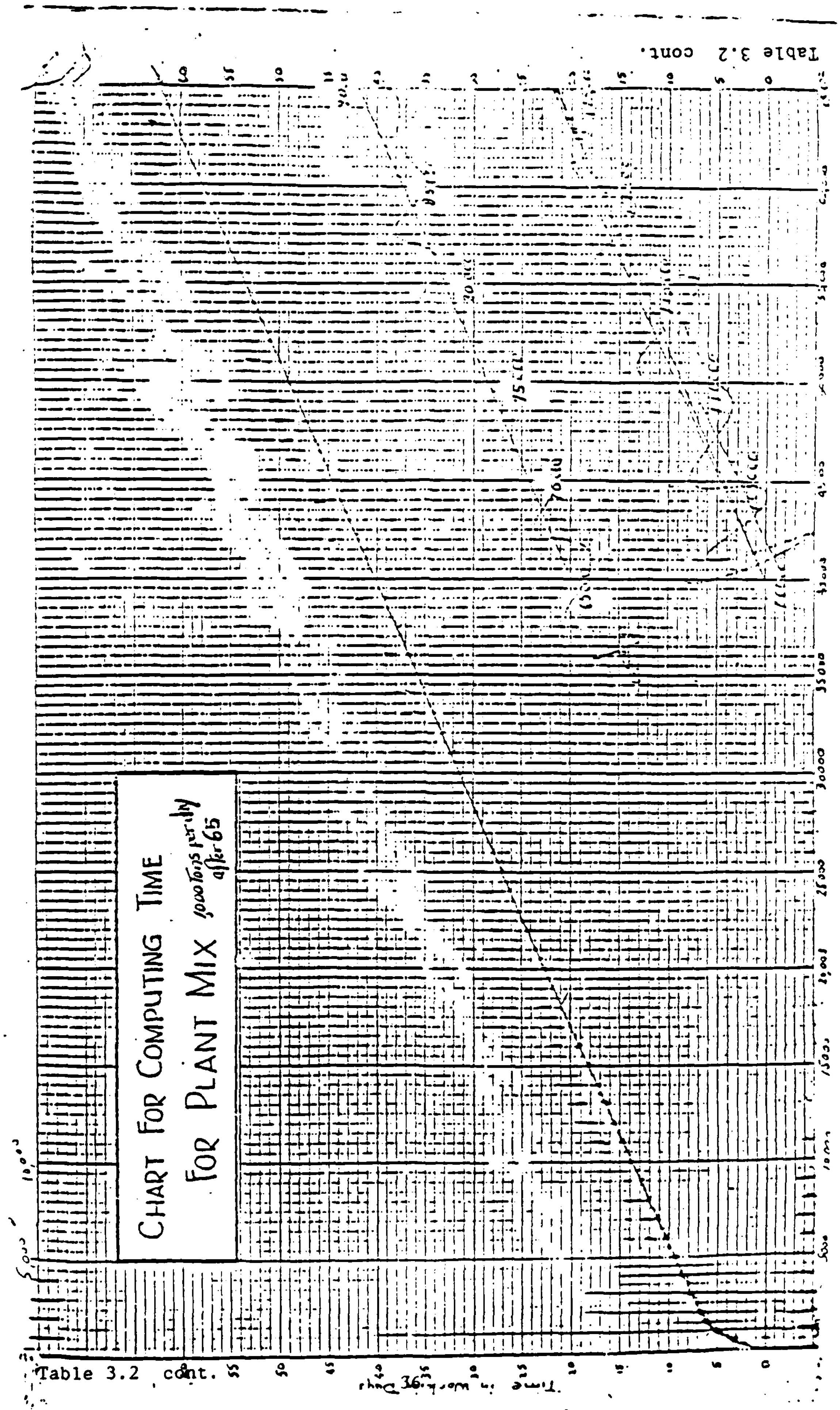

Table 3.2 cont.

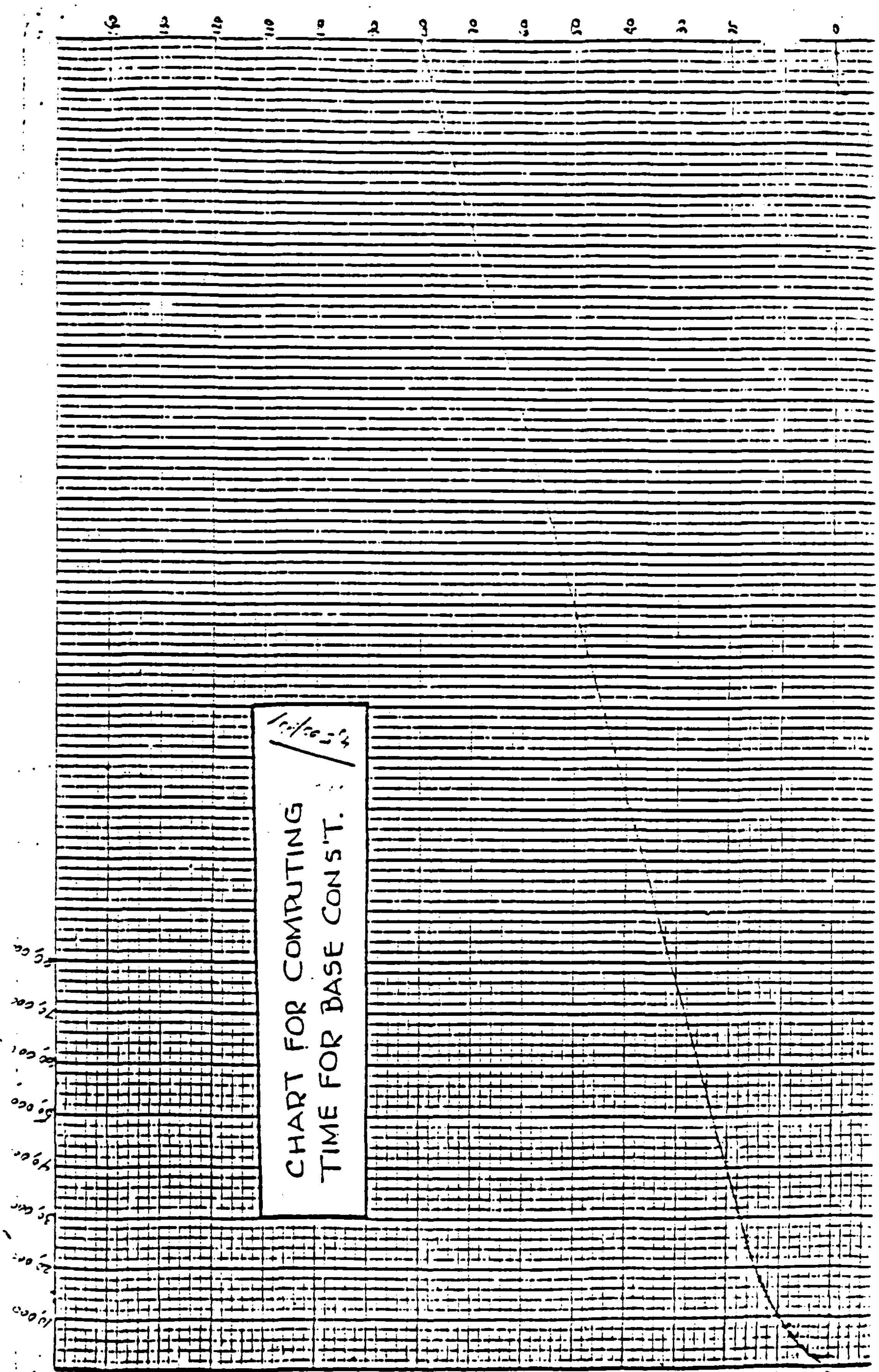

Table 3.2 cont.

associated with reconstruction were higher than improvements to intersections and bridges. This same correlation could be made for the local conditions and traffic conditions.

The following figure 3.2 is the weighted average of the percent increase or decrease that the project factors had on productivity when compared to the overall average of the work activities. To obtain these percentages the percent difference from each work activity and each factor i.e. construction, reconstruction, rural, light, etc., was combined into a weighted average. Each work activity's average productivity rate was used as a baseline. A partial sample of the equation used for the factor of construction follows. In this equation the numbers are obtained from the first three work activities of Clearing and Grubbing, Excavation, and Stabilizing.

Project Category: Construction

[(31*38.19%)+(30*119.68)+(25*77.44)+...]/[31+30+25+...]

= 42.59 %

By using the weighted average the percentages in figure 3.2 relate the factor's overall effect on productivity for the entire construction project.

PROJECT CATEGORY	
Construction	42.59
Reconstruction	- 1.61 %
Intersection	- 52.24
Bridge	- 36.26
LOCAL CONDITION	
Rural	18.50
Urban	- 26.69
Limited (Interstate)	39.08
TRAFFIC CONDITION	
Light	26.19
Medium	19.92
Heavy	- 15.70

Figure 3.2 Project Factors Percent Effect On Productivity.

It should be noted that the percentages in figure 3.2 are independent on each other for project category, local condition, and traffic condition. There was no way to relate the data from one condition to another using Lotus 123. It is interesting to note the wide range of difference between some of the items such as, Construction (42.59%) and Intersection (-52.24%). That is a 90 % range or difference in productivity rates.

The same procedure for weighing the averages of the factors contained on the Field Observation Work

Activity sheet (figure 3.1b) was also computed. Figure 3.3 contain these results. Of the factors measured in this survey the factor of Utility Delays had the most detrimental effect of productivity, and as expected the productivity rates where no factors were detrimental had the highest productivity rates.

PRODUCTIVITY FACTOR	
No Factor	16.98 %
Work Phasing Required By Contract	13.96
Weather	4.71
Insufficient Manpower Or Equipment	- 5.99
Other	- 18.61
Traffic	- 19.54
Utility	- 28.05

Figure 3.3 Work Activity Factors Percent Effect On Productivity.

The range of daily productivity rates received for each observation by the Resident Engineers was very wide. In all cases where there were more than a few observations the standard deviation was very large. In some instances the standard deviation was larger than the average productivity rate for the work activity. The wide range of productivity rates and the large standard deviations show that the normal distribution curve is flat and is probably not shaped symmetrically.

1. CLEARING AND
GRUBING (ACRES)

	PROJECT CATEGORY				
	ORIGINAL	RECONSTRUCTION	CONSTRUCTION	INTERSECTION	BRIDGE
NUMBER OF SAMPLES	106	53	31	7	15
TOTAL UNITS WORKED	242	136	98	2	7
TOTAL HOURS WORKED	829	409	291	19	112
AVERAGE HOURS WORKED/DAY	7.82	7.71	9.37	2.64	7.43
HOURLY STAN. DEV.	2.83	2.78	1.42	0.79	2.68
HOURLY VARIANCE	8.02	7.74	2.02	0.62	7.16
AVERAGE UNITS WORKED/DAY	2.29	2.56	3.16	0.27	0.45
DAILY QUANTITY STAN. DEV.	2.52	2.18	3.19	0.32	0.42
DAILY QUANTITY VARIANCE	6.37	4.73	10.15	0.10	0.17
DAILY HIGH	11.19	8.23	11.19	1.04	1.00
DAILY LOW	0.018	0.100	0.13	0.02	0.02
PERCENT DIFFERENCE FROM THE AVERAGE		12.02%	38.19%	-88.08%	-80.32%

Table 3.3 UF Survey Clearing and Grubbing

1. cont. CLEARING AND
GRUBING (ACRES)

	LOCAL CONDITIONS			TRAFFIC CONDITIONS		
	RURAL	URBAN	LIMITED	LIGHT	MEDIUM	HEAVY
NUMBER OF SAMPLES	50	42	14	10	48	48
TOTAL UNITS WORKED	103	79	60	19	118	106
TOTAL HOURS WORKED	439	255	135	87	407	336
AVERAGE HOURS WORKED/DAY	8.78	6.07	9.64	8.70	8.47	6.99
HOURLY STAN. DEV.	1.98	3.14	1.17	2.18	2.54	3.00
HOURLY VARIANCE	3.91	9.85	1.37	4.76	6.46	8.97
AVERAGE UNITS WORKED/DAY	2.06	1.89	4.29	1.89	2.46	2.20
DAILY QUANTITY STAN. DEV.	2.17	2.86	1.45	1.60	2.01	3.07
DAILY QUANTITY VARIANCE	4.72	8.20	2.10	2.57	4.02	9.44
DAILY HIGH	8.23	11.19	6.00	4.96	7.98	11.19
DAILY LOW	0.13	0.02	0.50	0.19	0.13	0.02
PERCENT DIFFERENCE FROM THE AVERAGE	-9.91%	-17.46%	87.70%	-17.39%	7.50%	-3.87%

Table 3.3 cont.

1. cont. CLEARING AND
GRUBING (ACRES)

	TYPE		
	LT	MED	HVY
NUMBER OF SAMPLES	30	35	23
TOTAL UNITS WORKED	66	63	78
TOTAL HOURS WORKED	214	366	200
AVERAGE HOURS WORKED/DAY	7.13	10.46	8.70
HOURLY STAN. DEV.	3.07	1.93	2.11
HOURLY VARIANCE	9.77	3.32	4.65
AVERAGE UNITS WORKED/DAY	1.79	1.81	3.39
DAILY QUANTITY STAN. DEV.	2.94	1.81	2.45
DAILY QUANTITY VARIANCE	8.95	3.38	6.27
DAILY HIGH	11.19	7.98	8.23
DAILY LOW	0.02	0.02	0.15
PERCENT DIFFERENCE FROM THE ORIGINAL	-21.71%	-20.82%	48.41%

Table 3.3 cont.

1. cont. CLEARING AND
GRUBING (ACRES)

	FACTORS WHICH HAD AN EFFECT ON PRODUCTION							
	WEATHER	TRAFFIC	MANPOWER OR EQUIP	UTILITY DELAYS	WORK PHASING	BURNING	OTHER	NO FACTORS
NUMBER OF SAMPLES	24	19	7	18	24	17	25	36
TOTAL UNITS WORKED	54	12	16	15	80	63	43	82
TOTAL HOURS WORKED	163	71	48	121	164	109	198	312
AVERAGE HOURS WORKED/DAY	6.79	3.71	6.86	6.69	6.81	6.41	7.92	8.65
HOURLY STAN. DEV.	3.32	2.78	1.81	3.56	3.50	3.71	2.52	1.87
HOURLY VARIANCE	11.48	8.18	3.81	13.45	12.78	14.60	6.64	3.61
AVERAGE UNITS WORKED/DAY	2.26	0.61	2.32	0.86	3.35	3.68	1.71	2.27
DAILY QUANTITY STAN. DEV.	2.40	0.80	1.85	0.71	3.22	3.60	1.97	2.05
DAILY QUANTITY VARIANCE	6.02	0.67	4.01	0.54	10.80	13.74	4.05	4.31
DAILY HIGH	8.23	2.40	5.10	2.40	11.19	11.19	5.65	7.98
DAILY LOW	0.13	0.02	0.10	0.13	0.18	0.18	0.02	0.15
PERCENT DIFFERENCE FROM THE ORIGINAL	-1.20%	-73.19%	1.34%	-62.49%	46.63%	60.84%	-25.32%	-0.81%

Table 3.3 cont.

2. EXCAVATION
(CUBIC YARDS)

	PROJECT CATEGORY				
	ORIGINAL	RECONSTRUCTION	CONSTRUCTION	INTERSECTION	BRIDGE
NUMBER OF SAMPLES	122	71	30	16	5
TOTAL UNITS WORKED	127,308	49,509	68,773	2,618	6,408
TOTAL HOURS WORKED	1,022	604	288	81	50
AVERAGE HOURS WORKED/DAY	8.38	8.50	9.60	5.03	10.00
HOURLY STAN. DEV.	3	2	1	3	0
HOURLY VARIANCE	6	6	1	7	0
AVERAGE UNITS WORKED/DAY	1,044	697	2,292	164	1,282
DAILY QUANTITY STAN. DEV.	1,503	613	2,446	190	402
DAILY QUANTITY VARIANCE	2,258,059	375,319	5,982,590	35,949	161,764
DAILY HIGH	12,451	2,136	12,451	773	1,300
DAILY LOW	7	12	178	7	732
PERCENT DIFFERENCE FROM THE AVERAGE		-33.18%	119.68%	-84.32%	22.82%

Table 3.4 UF Survey Excavation

2. cont. EXCAVATION
(CUBIC YARDS)

	LOCAL CONDITIONS			TRAFFIC CONDITIONS		
	RURAL	URBAN	LIMITED	LIGHT	MEDIUM	HEAVY
NUMBER OF SAMPLES	60	52	10	10	48	64
TOTAL UNITS WORKED	80,056	31,518	15,734	9,438	77,124	40,746
TOTAL HOURS WORKED	519	404	100	60	453	510
AVERAGE HOURS WORKED/DAY	8.64	7.76	10.00	5.95	9.43	7.97
HOURLY STAN. DEV.	3	2	0	4	2	2
HOURLY VARIANCE	7	6	0	12	4	6
AVERAGE UNITS WORKED/DAY	1,334	606	1,573	944	1,607	637
DAILY QUANTITY STAN. DEV.	1,957	713	391	865	2,106	675
DAILY QUANTITY VARIANCE	3,828,475	507,996	152,999	749,043	4,435,981	455,391
DAILY HIGH	12,451	2,856	2,136	2,114	12,451	2,856
DAILY LOW	41	7	750	62	41	7
PERCENT DIFFERENCE FROM THE AVERAGE	27.86%	-41.92%	50.78%	-9.56%	53.98%	-38.99%

Table 3.4 cont.

3. cont. EXCAVATION
(CUBIC YARD)

	TYPE OF EXCAVATION			TYPE OF SOIL		
	REGULAR	LATTERAL DITCH	SUBSOIL	SAND	CLAY	ROCK
NUMBER OF SAMPLES	90	5	15	107	26	5
TOTAL UNITS WORKED	91,240	3,466	14,778	105,989	35,408	934
TOTAL HOURS WORKED	718	58	131	675	226	32
AVERAGE HOURS WORKED/DAY	7.98	11.50	8.70	8.18	8.69	6.40
HOURLY STAN. DEV.	2.61	1.48	2.23	2.64	2.34	1.96
HOURLY VARIANCE	6.80	2.20	4.99	6.98	5.46	3.84
AVERAGE UNITS WORKED/DAY	1,014	693	985	991	1,362	187
DAILY QUANTITY STAN. DEV.	1,654	214	1,112	1,572	904	153
DAILY QUANTITY VARIANCE	2,734,757	45,608	1,236,918	2,471,219	817,574	23,432
DAILY HIGH	12,451	1,095	3,800	12,451	3,800	458
DAILY LOW	7	496	12	7	127	13
PERCENT DIFFERENCE FROM THE ORIGINAL	-2.85%	-33.57%	-5.59%	-5.07%	30.51%	-82.11%

Table 3.4 cont

2. cont. EXCAVATION
(CUBIC YARD)

	FACTORS WHICH HAD AN EFFECT ON PRODUCTION						
	WEATHER	TRAFFIC	MANPOWER OR EQUIP	UTILITY DELAYS	WORK PHASING	OTHER	NO FACTORS
NUMBER OF SAMPLES	34	51	25	33	33	27.00	13.00
TOTAL UNITS WORKED	32,314	23,983	28,695	24,158	49,041	22,811	14,071
TOTAL HOURS WORKED	294	403	221	290	256	214.50	119.50
AVERAGE HOURS WORKED/DAY	8.63	7.89	8.84	8.77	7.76	7.94	9.19
HOURLY STAN. DEV.	2.31	2.35	1.86	1.91	2.97	3.46	2.29
HOURLY VARIANCE	5.36	5.53	3.47	3.65	8.80	11.99	5.24
AVERAGE UNITS WORKED/DAY	950	470	1,148	732	1,486	845	1,082
DAILY QUANTITY STAN. DEV.	862	632	975	664	2,592	822	547
DAILY QUANTITY VARIANCE	743,492	398,850	949,701	441,213	6,716,104	675,614	299,556
DAILY HIGH	3,800	2,856	3,800	2,136	12,451	2,356	1,800
DAILY LOW	37	12	12	12	13	60	7
PERCENT DIFFERENCE FROM THE ORIGINAL	-8.92%	-54.93%	9.99%	-29.85%	42.41%	-19.04%	3.73%

Table 3.4 cont.

3. STABILIZING
(SQUARE YARDS)

	PROJECT CATORGY				
	ORIGINAL	RECONSTRUCTION	CONSTRUCTION	INTERSECTION	BRIDGE
NUMBER OF SAMPLES	78	42	25	6	5
TOTAL UNITS WORKED	361,614	130,382	205,651	22,411	3,170
TOTAL HOURS WORKED	662	323	229	60	50
AVERAGE HOURS WORKED/DAY	8.48	7.69	9.14	10.00	10.00
HOURLY STAN. DEV.	2.14	2.18	1.95	0.00	0.00
HOURLY VARIANCE	4.57	4.74	3.80	0.00	0.00
AVERAGE UNITS WORKED/DAY	4,636	3,104	8,226	3,735	634
DAILY QUANTITY STAN. DEV.	8,481	3,707	13,448	972	0
DAILY QUANTITY VARIANCE	71,922,466	13,745,157	180,851,761	945,057	0
DAILY HIGH	69,672	14,700	69,672	5,100	634
DAILY LOW	62	62	533	2,256	634
PERCENT DIFFERENCE FROM THE AVERAGE		-33.04%	77.44%	-19.43%	-86.32%

Table 3.5 UF Survey Stabilizing

3. cont. STABILIZING
(SQUARE YARDS)

	LOCAL CONDITIONS			TRAFFIC CONDITIONS		
	RURAL	URBAN	LIMITED	LIGHT	MEDIUM	HEAVY
NUMBER OF SAMPLES	42	36	0	6	31	41
TOTAL UNITS WORKED	291,104	70,510		63,462	203,104	95,048
TOTAL HOURS WORKED	375	287		52	286	324
AVERAGE HOURS WORKED/DAY	8.92	7.97		8.67	9.23	7.39
HOURLY STAN. DEV.	1.80	2.37		0.75	2.30	2.20
HOURLY VARIANCE	3.24	5.64		0.56	5.39	4.82
AVERAGE UNITS WORKED/DAY	6,931	1,959		10,577	6,552	2,318
DAILY QUANTITY STAN. DEV.	10,862	2,208		3,759	12,418	2,203
DAILY QUANTITY VARIANCE	117,979,953	4,875,312		14,133,468	154,204,287	4,854,276
DAILY HIGH	69,672	7,466		14,700	69,672	7,466
DAILY LOW	328	62		3,788	328	62
PERCENT DIFFERENCE FROM THE AVERAGE	49.50%	-57.75%		128.15%	41.32%	-50.00%

Table 3.5 cont.

3. cont. STABILIZING
(SQUARE YARD)

FACTORS WHICH HAD AN EFFECT ON PRODUCTION

	WEATHER	TRAFFIC	MANPOWER OR EQUIP	UTILITY DELAYS	WORK PHASING	OTHER	NO FACTORS
NUMBER OF SAMPLES	37	19	20	17	23	13	15
TOTAL UNITS WORKED	186,900	17,273	122,997	17,516	213,769	53,365	59,057
TOTAL HOURS WORKED	322	124	186	149	209	145	134
AVERAGE HOURS WORKED/DAY	8.70	6.53	9.30	8.74	9.09	8.03	8.93
HOURLY STAN. DEV.	1.42	2.66	1.47	1.43	1.48	2.54	2.24
HOURLY VARIANCE	2.02	7.09	2.16	2.03	2.20	6.39	5.00
AVERAGE UNITS WORKED/DAY	5,051	909	6,150	1,030	9,294	2,365	3,337
DAILY QUANTITY STAN. DEV.	11,560	1,023	15,490	532	14,208	2,590	1,154
DAILY QUANTITY VARIANCE	1.3E+08	1.0E+06	2.4E+08	2.3E+05	2.0E+08	6.7E+06	1.3E+06
DAILY HIGH	69,672	4,403	69,672	2,533	69,672	7,466	5,776
DAILY LOW	62	62	62	328	328	150	1,731
PERCENT DIFFERENCE FROM THE AVERAGE	8.96%	-80.39%	32.65%	-77.77%	100.48%	-36.05%	-15.08%

Table 3.5 cont.

4. BASE CONSTRUCTION
(SQUARE YARDS)

			PROJECT CATORGY		
	ORIGINAL	RECONSTRUCTION	CONSTRUCTION	INTERSECTION	BRIDGE
NUMBER OF SAMPLES	160	107	25	23	5
TOTAL UNITS WORKED	270,535	200,970	47,705	16,739	5,120
TOTAL HOURS WORKED	1,450	971	242	133	45
AVERAGE HOURS WORKED/DAY	9.06	9.07	9.66	8.37	9.00
HOURLY STAN. DEV.	2.33	2.52	1.35	1.48	2.00
HOURLY VARIANCE	5.41	6.36	3.79	2.20	4.00
AVERAGE UNITS WORKED/DAY	1,691	1,878	1,908	728	1,024
DAILY QUANTITY STAN. DEV.	1,646	1,705	1,725	917	0
DAILY QUANTITY VARIANCE	2,708,719	2,907,990	2,975,740	841,458	0
DAILY HIGH	10,923	10,923	6,400	2,900	1,024
DAILY LOW	14	14	78	50	1,024
PERCENT DIFFERENCE FROM THE AVERAGE		11.08%	12.86%	-56.96%	-39.44%

Table 3.6 UF Survey Base Construction

4. cont. BASE CONSTRUCTION
(SQUARE YARDS)

	LOCAL CONDITIONS			TRAFFIC CONDITIONS		
	RURAL	URBAN	LIMITED	LIGHT	MEDIUM	HEAVY
NUMBER OF SAMPLES	38	72	0	18	65	77
TOTAL UNITS WORKED	194,489	76,046		36,101	132,073	102,361
TOTAL HOURS WORKED	347	604		180	547	623
AVERAGE HOURS WORKED/DAY	9.62	8.38		10.00	9.35	3.09
HOURLY STAN. DEV.	2.07	2.44		2.07	2.30	1.99
HOURLY VARIANCE	4.29	5.94		4.28	5.30	3.95
AVERAGE UNITS WORKED/DAY	2,210	1,056		2,006	2,032	1,329
DAILY QUANTITY STAN. DEV.	1,729	1,278		1,724	1,687	1,510
DAILY QUANTITY VARIANCE	2,989,615	1,633,079		2,971,399	2,846,186	2,279,248
DAILY HIGH	10,923	6,400		6,422	10,923	6,400
DAILY LOW	78	14		140	76	14
PERCENT DIFFERENCE FROM THE AVERAGE	30.71%	-37.53%		18.62%	20.17%	-21.38%

Table 3.6 cont.

4. cont. BASE CONSTRUCTION
(SQUARE YARD)

	TYPE OF MATERIAL				
	SAND CLAY	LIME ROCK	SHELL STABILIZED	SOIL CEMENT	ASPHALTIC BASE
NUMBER OF SAMPLES	5	93	0	0	52
TOTAL UNITS WORKED	16,808	150,746			81,425
TOTAL HOURS WORKED	44	841			471
AVERAGE HOURS WORKED/DAY	8.70	9.04			9.05
HOURLY STAN. DEV.	1.03	1.93			3.12
HOURLY VARIANCE	1.06	3.73			9.74
AVERAGE UNITS WORKED/DAY	3,362	1,621			1,566
DAILY QUANTITY STAN. DEV.	1,065	1,480			1,932
DAILY QUANTITY VARIANCE	1,135,128	2,139,808			3,731,255
DAILY HIGH	4,746	6,422			10,923
DAILY LOW	1,794	14			49
PERCENT DIFFERENCE FROM THE AVERAGE	98.81%	-4.13%			-7.39%

Table 3.6 cont.

4. cont. BASE CONSTRUCTION
(SQUARE YARD)

	FACTORS WHICH HAD AN EFFECT ON PRODUCTION						
	WEATHER	TRAFFIC	MANPOWER OR EQUIP	UTILITY DELAYS	WORK PHASING	OTHER	NO FACTORS
NUMBER OF SAMPLES	64	67	20	14	28	32	34
TOTAL UNITS WORKED	124,832	86,202	34,026	16,552	28,089	40,353	73,841
TOTAL HOURS WORKED	599	562	192	117	242	266	325
AVERAGE HOURS WORKED/DAY	9.35	8.39	9.60	8.32	8.63	8.31	9.56
HOURLY STAN. DEV.	1.74	2.60	2.28	2.10	2.78	2.92	1.72
HOURLY VARIANCE	3.02	6.74	5.22	4.41	7.73	8.53	2.97
AVERAGE UNITS WORKED/DAY	1,951	1,287	1,701	1,182	1,003	1,277	2,172
DAILY QUANTITY STAN. DEV.	1,359	1,570	1,811	748	780	1,572	2,002
DAILY QUANTITY VARIANCE	1,846,224	2,465,126	3,279,141	560,232	608,906	2,470,685	4,007,832
DAILY HIGH	6,400	6,400	6,422	2,767	3,533	6,422	10,923
DAILY LOW	78	14	55	178	97	49	76
PERCENT DIFFERENCE FROM THE AVERAGE	15.36%	-23.91%	0.62%	-30.08%	-40.67%	-24.50%	28.45%

Table 3.6 cont.

5. SURFACE TREATMENT (CUBIC YARD)

			PROJECT CATEGORY		
	ORIGINAL	RECONSTRUCTION	CONSTRUCTION	INTERSECTION	BRIDGE
NUMBER OF SAMPLES	22	22	0	0	0
TOTAL UNITS WORKED	14,370	14,370			
TOTAL HOURS WORKED	181	181			
AVERAGE HOURS WORKED/DAY	8.23	8.23			
HOURLY STAN. DEV.	2.29	2.29			
HOURLY VARIANCE	5.25	5.25			
AVERAGE UNITS WORKED/DAY	653	653			
DAILY QUANTITY STAN. DEV.	634	634			
DAILY QUANTITY VARIANCE	401,375	401,375			
DAILY HIGH	2,239	2,239			
DAILY LOW	35	35			
PERCENT DIFFERENCE FROM THE AVERAGE		0.00%			

Table 3.7 UF Survey Surface Treatment

5. cont. SURFACE TREATMENT
(CUBIC YARD)

	LOCAL CONDITIONS			TRAFFIC CONDITIONS		
	RURAL	URBAN	LIMITED	LIGHT	MEDIUM	HEAVY
NUMBER OF SAMPLES	19	3	0	1	16	5
TOTAL UNITS WORKED	14,023	347		35	10,185	4,150
TOTAL HOURS WORKED	148	34		8	137	36
AVERAGE HOURS WORKED/DAY	7.77	11.17		8.00	8.58	7.16
HOURLY STAN. DEV.	1.99	1.89		0.00	2.58	0.57
HOURLY VARIANCE	3.94	3.56		0.00	6.64	0.33
AVERAGE UNITS WORKED/DAY	738	116		35	637	830
DAILY QUANTITY STAN. DEV.	642	50		0	708	230
DAILY QUANTITY VARIANCE	411,531	2,477		0	501,445	52,949
DAILY HIGH	2,239	171		35	2,239	1,040
DAILY LOW	35	50		35	50	496
PERCENT DIFFERENCE FROM THE AVERAGE	12.99%	-82.29%		-94.57%	-2.55%	27.07%

Table 3.7 cont.

5. cont. SURFACE TREATMENT
(CUBIC YARDS)

FACTORS WHICH HAD AN EFFECT ON PRODUCTION

	WEATHER	TRAFFIC	MANPOWER OR EQUIP	UTILITY DELAYS	WORK PHASING	OTHER	NO FACTORS
NUMBER OF SAMPLES	9	13	0	0	0	0	4
TOTAL UNITS WORKED	8,264	6,308					382
TOTAL HOURS WORKED	83	100					42
AVERAGE HOURS WORKED/DAY	9.22	7.66					10.38
HOURLY STAN. DEV.	1.69	2.39					2.13
HOURLY VARIANCE	2.84	5.73					4.55
AVERAGE UNITS WORKED/DAY	918	485					96
DAILY QUANTITY STAN. DEV.	831	327					55
DAILY QUANTITY VARIANCE	690,807	106,897					[illegible]
DAILY HIGH	2,239	1,040					171
DAILY LOW	105	105					35
PERCENT DIFFERENCE FROM THE AVERAGE	40.57%	-25.72%					-85.36%

Table 3.7 cont.

6. CONCRETE PAVEMENT
(SQUARE YARD)

	PROJECT CATEGORY				
	ORIGINAL	RECONSTRUCTION	CONSTRUCTION	INTERSECTION	BRIDGE
NUMBER OF SAMPLES	15	5	0	0	10
TOTAL UNITS WORKED	1,226	323			903
TOTAL HOURS WORKED	155	55			100
AVERAGE HOURS WORKED/DAY	10.33	11.00			10.00
HOURLY STAN. DEV.	0.51	0.32			0.00
HOURLY VARIANCE	0.26	0.10			0.00
AVERAGE UNITS WORKED/DAY	82	65			90
DAILY QUANTITY STAN. DEV.	44	12			51
DAILY QUANTITY VARIANCE	1,894	139			2,550
DAILY HIGH	136	83			136
DAILY LOW	8	47			8
PERCENT DIFFERENCE FROM THE AVERAGE		-21.03%			10.51%

Table 3.8 UF Survey Concrete Pavement

6. cont. CONCRETE PAVEMENT
(SQUARE YARD)

	LOCAL CONDITIONS			TRAFFIC CONDITIONS		
	RURAL	URBAN	LIMITED	LIGHT	MEDIUM	HEAVY
NUMBER OF SAMPLES	10	5	0	0	5	10
TOTAL UNITS WORKED	546	680			323	903
TOTAL HOURS WORKED	105	50			55	100
AVERAGE HOURS WORKED/DAY	10.50	10.00			11.00	10.00
HOURLY STAN. DEV.	0.55	0.00			0.32	0.00
HOURLY VARIANCE	0.30	0.00			0.10	0.00
AVERAGE UNITS WORKED/DAY	55	136			65	90
DAILY QUANTITY STAN. DEV.	25	0			12	51
DAILY QUANTITY VARIANCE	631	0			139	2,550
DAILY HIGH	96	136			83	136
DAILY LOW	8	136			47	8
PERCENT DIFFERENCE FROM THE AVERAGE	-33.22%	66.44%			-21.03%	10.51%

Table 3.8 cont.

6. cont. CONCRETE PAVEMENT
(SQUARE YARD)

	THIKNESS		FACTORS WHICH HAD AN EFFECT ON PRODUCTION						
	7"	3"	WEATHER	TRAFFIC	MANPOWER OR EQUIP	UTILITY DELAYS	WORK PHASING	OTHER	NO FACTORS
NUMBER OF SAMPLES	5	5	5	0	0	0	0	0	10
TOTAL UNITS WORKED	680	323	223						1,003
TOTAL HOURS WORKED	50	55	50						105
AVERAGE HOURS WORKED/DAY	10.00	11.00	10.00						10.50
HOURLY STAN. DEV.	0	0	0						0.55
HOURLY VARIANCE	0	0	0						0.30
AVERAGE UNITS WORKED/DAY	136	65	45						100
DAILY QUANTITY STAN. DEV.	0	12	30						37
DAILY QUANTITY VARIANCE	0	139	924						1,347
DAILY HIGH	136	83	96						136
DAILY LOW	136	47	8						47
PERCENT DIFFERENCE FROM THE AVERAGE	66.44%	-21.03%	******						22.71%

Table 3.8 cont.

7. MILLING EXISTING PAVEMENT
(SQUARE YARD)

	PROJECT CATEGORY				
	ORIGINAL	RECONSTRUCTION	CONSTRUCTION	INTERSECTION	BRIDGE
NUMBER OF SAMPLES	95	94	1	0	0
TOTAL UNITS WORKED	1,163,188	1,160,914	2,274		
TOTAL HOURS WORKED	944	938	6		
AVERAGE HOURS WORKED/DAY	9.94	9.98	6.00		
HOURLY STAN. DEV.	2.45	2.43	0.00		
HOURLY VARIANCE	6.01	5.91	0.00		
AVERAGE UNITS WORKED/DAY	12,244	12,350	2,274		
DAILY QUANTITY STAN. DEV.	7,461	7,429	0		
DAILY QUANTITY VARIANCE	55,669,694	55,193,201	0		
DAILY HIGH	32,028	32,028	2,274		
DAILY LOW	444	444	2,274		
PERCENT DIFFERENCE FROM THE AVERAGE		0.87%	-81.43%		

Table 3.9 UF Survey Milling Existing Pavement

7. cont. MILLING EXISTING PAVEMENT
(SQUARE YARD)

	LOCAL CONDITIONS			TRAFFIC CONDITIONS		
	RURAL	URBAN	LIMITED	LIGHT	MEDIUM	HEAVY
NUMBER OF SAMPLES	48	32	15	14	32	49
TOTAL UNITS WORKED	712,797	287,580	162,811	284,281	338,371	490,536
TOTAL HOURS WORKED	450	333	162	134	305	506
AVERAGE HOURS WORKED/DAY	9.37	10.39	10.80	9.54	9.52	10.33
HOURLY STAN. DEV.	2.72	1.93	2.07	3.34	2.28	2.18
HOURLY VARIANCE	7.38	3.71	4.29	11.16	5.21	4.75
AVERAGE UNITS WORKED/DAY	14,850	8,987	10,854	20,306	12,137	10,011
DAILY QUANTITY STAN. DEV.	8,108	4,847	6,765	8,159	7,680	5,180
DAILY QUANTITY VARIANCE	65,744,864	23,497,076	45,769,004	66,567,983	58,978,593	26,831,634
DAILY HIGH	32,028	20,533	26,422	32,028	29,376	26,422
DAILY LOW	444	2,351	3,833	5,488	444	2,274
PERCENT DIFFERENCE FROM THE AVERAGE	21.28%	-26.60%	-11.35%	65.84%	-0.88%	-18.24%

Table 3.9 cont.

7. cont. MILLING EXISTING PAVEMENT
(SQUARE YARD)

	FACTORS WHICH HAD AN EFFECT ON PRODUCTION						
	WEATHER	TRAFFIC	MANPOWER OR EQUIP	UTILITY DELAYS	WORK PHASING	OTHER	NO FACTORS
NUMBER OF SAMPLES	24		10	0	25	10	16
TOTAL UNITS WORKED	330,551	41[illegible].0	127,049		319,634	126,388	233,374
TOTAL HOURS WORKED	218	452	108		255	113	166
AVERAGE HOURS WORKED/DAY	9.06	10.05	10.75		10.18	11.30	10.34
HOURLY STAN. DEV.	2.39	2.30	2.04		2.29	1.27	2.30
HOURLY VARIANCE	5.74	5.29	4.16		5.26	1.61	3.43
AVERAGE UNITS WORKED/DAY	13,773	9,296	12,705		12,785	12,639	14,586
DAILY QUANTITY STAN. DEV.	7,315	5,553	6,826		6,112	5,333	10,183
DAILY QUANTITY VARIANCE	53,514,924	30,839,438	46,591,527		37,361,131	28,437,705	103,692,588
DAILY HIGH	32,028	26,422	26,400		26,422	20,533	30,500
DAILY LOW	2,586	2,274	4,444		5,472	4,444	444
PERCENT DIFFERENCE FROM THE AVERAGE	12.49%	-24.08%	3.76%		4.42%	3.22%	19.13%

Table 3.9 cont.

8. PLANT MIX SURFACE
STRUCTURAL COURSE (TONS)

		PROJECT CATEGORY			
	ORIGINAL	RECONSTRUCTION	CONSTRUCTION	INTERSECTION	BRIDGE
NUMBER OF SAMPLES	198	147	27	15	9
TOTAL UNITS WORKED	142,651	122,404	16,815	1,826	1,606
TOTAL HOURS WORKED	1,932	1,493	255	93	93
AVERAGE HOURS WORKED/DAY	9.76	10.16	9.43	6.17	10.28
HOURLY STAN. DEV.	2.63	2.25	2.81	3.59	0.53
HOURLY VARIANCE	6.94	5.06	7.88	12.86	0.28
AVERAGE UNITS WORKED/DAY	720	833	623	122	178
DAILY QUANTITY STAN. DEV.	565	533	639	111	70
DAILY QUANTITY VARIANCE	319,112	284,427	407,938	12,366	4,839
DAILY HIGH	2,863	2,359	2,863	356	274
DAILY LOW	6	6	114	10	84
PERCENT DIFFERENCE FROM THE AVERAGE		15.58%	-13.56%	-83.10%	-75.24%

Table 3.10 UF Survey Plant Mix Structural Course

8. cont. PLANT MIX SURFACE
STRUCTURAL COURSE (TONS)

	LOCAL CONDITIONS			TRAFFIC CONDITIONS		
	RURAL	URBAN	LIMITED	LIGHT	MEDIUM	HEAVY
NUMBER OF SAMPLES	111	72	15	20	81	97
TOTAL UNITS WORKED	94,874	31,423	16,354	23,780	66,561	52,310
TOTAL HOURS WORKED	1,098	666	169	233	800	899
AVERAGE HOURS WORKED/DAY	9.89	9.24	11.25	11.64	9.88	9.27
HOURLY STAN. DEV.	2.67	2.57	1.88	1.60	2.64	2.61
HOURLY VARIANCE	7.13	6.59	3.53	2.55	6.97	6.84
AVERAGE UNITS WORKED/DAY	855	436	1,090	1,189	822	539
DAILY QUANTITY STAN. DEV.	616	387	157	761	562	426
DAILY QUANTITY VARIANCE	379,794	149,961	24,638	579,724	316,178	181,167
DAILY HIGH	2,863	1,638	1,247	2,359	2,863	1,594
DAILY LOW	6	17	582	119	14	6
PERCENT DIFFERENCE FROM THE AVERAGE	18.64%	-39.42%	51.33%	65.03%	14.06%	-25.15%

Table 3.10 cont.

8. cont. PLANT MIX SURFACE
STRUCTURAL COURSE (TON)

FACTORS WHICH HAD AN EFFECT ON PRODUCTION

	WEATHER	TRAFFIC	MANPOWER OR EQUIP	UTILITY DELAYS	WORK PHASING	OTHER	NO FACTORS
NUMBER OF SAMPLES	74	95	18	0	34	34	40
TOTAL UNITS WORKED	55,278	58,474	16,781		15,318	21,578	33,390
TOTAL HOURS WORKED	728	929	182		334	335	387
AVERAGE HOURS WORKED/DAY	9.84	9.78	10.11		9.81	9.84	9.68
HOURLY STAN. DEV.	3	2.68	2.26		2.33	2.15	3.05
HOURLY VARIANCE	6	7.16	5.10		5.41	4.64	9.32
AVERAGE UNITS WORKED/DAY	747	616	932		451	635	835
DAILY QUANTITY STAN. DEV	559	466	634		433	575	665
DAILY QUANTITY VARIANCE	312,539	217,601	402,389		187,499	330,499	441,731
DAILY HIGH	2,104	2,104	2,104		1,602	2,863	2,359
DAILY LOW	6	14	133		14	14	10
PERCENT DIFFERENCE FROM THE AVERAGE	3.68%	-14.57%	29.40%		-37.47%	-11.91%	15.86%

Table 3.10 cont.

9. STORM SEWERS
(LINEAR FEET)

	ORIGINAL	PROJECT CATEGORY RECONSTRUCTION	CONSTRUCTION	INTERSECTION	BRIDGE
NUMBER OF SAMPLES	108	62	20	16	10
TOTAL UNITS WORKED	7,346	3,853	1,660	1,169	664
TOTAL HOURS WORKED	848	488	179	108	74
AVERAGE HOURS WORKED/DAY	7.85	7.86	8.93	6.75	7.40
HOURLY STAN. DEV.	2.25	2.28	1.83	2.22	1.76
HOURLY VARIANCE	5.04	5.21	3.36	4.94	3.09
AVERAGE UNITS WORKED/DAY	68	62	83	73	66
DAILY QUANTITY STAN. DEV	57	46	37	98	54
DAILY QUANTITY VARIANCE	3,204	2,083	1,371	9,554	2,957
DAILY HIGH	400	168	174	400	160
DAILY LOW	3	4	16	3	12
PERCENT DIFFERENCE FROM THE AVERAGE		-8.64%	22.03%	7.42%	-2.37%

Table 3.11 UF Survey Storm Sewers

9. cont. STORM SEWERS
(LINEAR FEET)

	LOCAL CONDITIONS			TRAFFIC CONDITIONS		
	RURAL	URBAN	LIMITED	LIGHT	MEDIUM	HEAVY
NUMBER OF SAMPLES	40	68	0	11	34	63
TOTAL UNITS WORKED	2,305	5,041		394	3,138	3,814
TOTAL HOURS WORKED	310	538		36	267	436
AVERAGE HOURS WORKED/DAY	7.75	7.91		7.77	7.84	7.37
HOURLY STAN. DEV.	2.51	2.07		3.31	1.79	2.24
HOURLY VARIANCE	6.33	4.28		10.97	3.19	5.01
AVERAGE UNITS WORKED/DAY	58	74		36	92	61
DAILY QUANTITY STAN. DEV.	38	64		27	67	49
DAILY QUANTITY VARIANCE	1,425	4,150		715	4,474	2,398
DAILY HIGH	174	400		73	400	174
DAILY LOW	4	3		4	16	3
PERCENT DIFFERENCE FROM THE AVERAGE	-15.29%	9.00%		-47.40%	35.70%	-10.99%

Table 3.11 cont.

3. cont. STORM SEWERS
(LINEAR FEET)

	AVERAGE DEPTH (FT)		DIAMETER (IN)	
	0 TO 5	5.1 TO 9	15 TO 18	24 TO 42
NUMBER OF SAMPLES	67	41	52	56
TOTAL UNITS WORKED	4,221	3,125	3,891	3,455
TOTAL HOURS WORKED	523	326	407	749
AVERAGE HOURS WORKED/DAY	7.80	7.94	7.83	13.38
HOURLY STAN. DEV.	2.30	2.14	2.45	2.25
HOURLY VARIANCE	5.31	4.60	6.02	5.08
AVERAGE UNITS WORKED/DAY	63	76	75	62
DAILY QUANTITY STAN. DEV.	63	43	62	50
DAILY QUANTITY VARIANCE	3,970	1,844	3,865	2,507
DAILY HIGH	400	174	400	168
DAILY LOW	3	12	7	3
PERCENT DIFFERENCE FROM THE AVERAGE	-7.38%	12.06%	10.02%	-9.30%

Table 3.11 cont.

3. cont. STORM SEWERS
(LINEAR FEET)

FACTORS WHICH HAD AN EFFECT ON PRODUCTION

	WEATHER	TRAFFIC	MANPOWER OR EQUIP	UTILITY DELAYS	WORK PHASING	OTHER	NO FACTORS
NUMBER OF SAMPLES	38	37	27	34	7	24	17
TOTAL UNITS WORKED	2,265	2,604	1,361	2,510	582	1,587	1,687
TOTAL HOURS WORKED	273	284	229	262	49	175	152
AVERAGE HOURS WORKED/DAY	7.17	7.68	8.48	7.69	6.93	7.29	8.94
HOURLY STAN. DEV.	2.24	1.91	1.76	2.75	2.68	1.99	2.07
HOURLY VARIANCE	5.00	3.65	3.08	7.59	7.17	3.96	4.29
AVERAGE UNITS WORKED/DAY	60	70	50	74	83	66	99
DAILY QUANTITY STAN. DEV.	46	74	40	44	20	98	45
DAILY QUANTITY VARIANCE	2,110	5,499	1,594	1,905	398	7,679	1,996
DAILY HIGH	174	400	174	174	108	400	166
DAILY LOW	3	6	8	9	44	3	4
PERCENT DIFFERENCE FROM THE AVERAGE	-12.36%	3.48%	-25.89%	8.54%	22.24%	-2.78%	45.86%

Table 3.11 cont.

10. CURB AND GUTTER
(LINEAR FEET)

		PROJECT CATEGORY			
	ORIGINAL	RECONSTRUCTION	CONSTRUCTION	INTERSECTION	BRIDGE
NUMBER OF SAMPLES	93	50	20	18	5
TOTAL UNITS WORKED	31,110	17,482	8,468	3,499	1,661
TOTAL HOURS WORKED	750	383	198	131	38
AVERAGE HOURS WORKED/DAY	8.06	7.66	9.90	7.28	7.50
HOURLY STAN. DEV.	2.07	1.92	1.81	1.16	3.01
HOURLY VARIANCE	4.30	3.68	3.27	1.34	9.04
AVERAGE UNITS WORKED/DAY	335	350	423	194	332
DAILY QUANTITY STAN. DEV	344	367	397	149	185
DAILY QUANTITY VARIANCE	118,012	134,773	157,287	22,089	34,051
DAILY HIGH	1,402	1,302	1,402	710	521
DAILY LOW	0	18	34	0	70
PERCENT DIFFERENCE FROM THE AVERAGE		4.52%	26.57%	-41.89%	-0.69%

Table 3.12 UF Survey Curb and Gutter

10. cont. CURB AND GUTTER
(LINEAR FEET)

	LOCAL CONDITIONS			TRAFFIC CONDITIONS		
	RURAL	URBAN	LIMITED	LIGHT	MEDIUM	HEAVY
NUMBER OF SAMPLES	28	65	0	0	36	57
TOTAL UNITS WORKED	12,410	18,701			15,277	15,833
TOTAL HOURS WORKED	246	718			298	666
AVERAGE HOURS WORKED/DAY	8.79	11.05			8.28	11.68
HOURLY STAN. DEV.	2.26	13.80			2.49	14.68
HOURLY VARIANCE	5.12	190.36			6.19	215.60
AVERAGE UNITS WORKED/DAY	443	288			424	278
DAILY QUANTITY STAN. DEV.	361	325			362	318
DAILY QUANTITY VARIANCE	130,563	105,324			131,389	101,244
DAILY HIGH	1,402	1,302			1,402	1,302
DAILY LOW	0	18			18	0
PERCENT DIFFERENCE FROM THE AVERAGE	32.49%	-14.00%			26.86%	-16.96%

Table 3.12 cont.

13. cont. CURB AND GUTTER
(LINEAR FEET)

	FACTORS WHICH HAD AN EFFECT ON PRODUCTION						
	WEATHER	TRAFFIC	MANPOWER OR EQUIP	UTILITY DELAYS	WORK PHASING	OTHER	NO FACTORS
NUMBER OF SAMPLES	24	22	10	10	[illegible]	23	34
TOTAL UNITS WORKED	6,198	2,297	1,300	3,249	1,358	4,755	16,349
TOTAL HOURS WORKED	208	147	33	36	71	120	239
AVERAGE HOURS WORKED/DAY	3.65	6.68	3.25	3.60	3.91	5.20	3.50
HOURLY STAN. DEV.	1.91	1.93	0.78	1.92	0.93	0.71	2.11
HOURLY VARIANCE	3.63	3.74	0.61	3.69	0.37	0.50	4.47
AVERAGE UNITS WORKED/DAY	258	104	130	325	170	266	498
DAILY QUANTITY STAN. DEV.	183	71	93	225	135	245	447
DAILY QUANTITY VARIANCE	33,346	5,057	8,678	50,511	18,098	59,856	200,240
DAILY HIGH	788	290	304	788	402	891	1,402
DAILY LOW	34	18	54	42	34	47	0
PERCENT DIFFERENCE FROM THE AVERAGE	-22.80%	-68.78%	-46.19%	-2.87%	-49.26%	-20.53%	48.94%

Table 3.12 cont.

11. SIDEWALK
(SQUARE YARD)

			PROJECT CATEGORY		
	ORIGINAL	RECONSTRUCTION	CONSTRUCTION	INTERSECTION	BRIDGE
NUMBER OF SAMPLES	35	26	5	4	0
TOTAL UNITS WORKED	4,542	3,329	1,016	197	
TOTAL HOURS WORKED	403	317	50	36	
AVERAGE HOURS WORKED/DAY	11.50	12.19	10.00	8.38	
HOURLY STAN. DEV.	8.37	9.60	0.00	0.89	
HOURLY VARIANCE	70.07	92.23	0.00	0.80	
AVERAGE UNITS WORKED/DAY	130	128	203	49	
DAILY QUANTITY STAN. DEV.	161	180	40	29	
DAILY QUANTITY VARIANCE	25,985	32,505	1,613	848	
DAILY HIGH	957	957	257	97	
DAILY LOW	2	2	142	21	
PERCENT DIFFERENCE FROM THE AVERAGE		-1.34%	56.57%	-61.97%	

Table 3.13 UF Survey Sidewalk

11. cont. SIDEWALK
(SQUARE YARD)

	LOCAL CONDITIONS			TRAFFIC CONDITIONS		
	RURAL	URBAN	LIMITED	LIGHT	MEDIUM	HEAVY
NUMBER OF SAMPLES	5	30	0	0	5	29
TOTAL UNITS WORKED	1,016	3,526			254	4,238
TOTAL HOURS WORKED	50	353			39	364
AVERAGE HOURS WORKED/DAY	10.00	11.75			6.42	12.55
HOURLY STAN. DEV.	0.00	9.02			1.88	8.80
HOURLY VARIANCE	0.00	81.31			3.53	77.39
AVERAGE UNITS WORKED/DAY	203	118			42	148
DAILY QUANTITY STAN. DEV.	40	170			19	171
DAILY QUANTITY VARIANCE	1,613	28,999			371	29,375
DAILY HIGH	257	957			75	957
DAILY LOW	142	2			21	2
PERCENT DIFFERENCE FROM THE AVERAGE	56.57%	-9.43%			-67.38%	13.94%

Table 3.13 cont.

31. cont. SIDEWALK
(SQUARE YARD)

FACTORS WHICH HAD AN EFFECT ON PRODUCTION

	WEATHER	TRAFFIC	MANPOWER OR EQUIP	UTILITY DELAYS	WORK PHASING	OTHER	NO FACTORS
NUMBER OF SAMPLES	10	14	0	7	7	15	[illegible]
TOTAL UNITS WORKED	2,608	784		1,159	590	330	560
TOTAL HOURS WORKED	92	101		70	174	214	[illegible]
AVERAGE HOURS WORKED/DAY	9.20	7.18		9.93	24.79	14.23	9.13
HOURLY STAN. DEV.	0.98	1.45		0.17	10.94	11.32	0.39
HOURLY VARIANCE	0.96	2.09		0.03	119.70	128.23	[illegible]
AVERAGE UNITS WORKED/DAY	261	56		166	84	75	140
DAILY QUANTITY STAN. DEV.	247	40		70	32	42	[illegible]
DAILY QUANTITY VARIANCE	61,080	1,610		4,870	1,037	1,739	1,538
DAILY HIGH	957	166		257	144	166	180
DAILY LOW	54	2		46	46	1	75
PERCENT DIFFERENCE FROM THE AVERAGE	100.95%	-56.85%		27.62%	-35.01%	-42.45%	7.87%

Table 3.13 cont.

12. SEED AND MULCH
(SQUARE YARD)

	PROJECT CATEGORY				
	ORIGINAL	RECONSTRUCTION	CONSTRUCTION	INTERSECTION	BRIDGE
NUMBER OF SAMPLES	58	39	14	1	4
TOTAL UNITS WORKED	1,367,493	790,624	547,400	9,929	19,540
TOTAL HOURS WORKED	447	272	145	5	26
AVERAGE HOURS WORKED/DAY	7.71	6.98	10.32	5.00	6.38
HOURLY STAN. DEV.	3.17	2.60	3.53	0.00	1.78
HOURLY VARIANCE	10.04	6.78	12.49	0.00	3.17
AVERAGE UNITS WORKED/DAY	23,577	20,272	39,100	9,929	4,885
DAILY QUANTITY STAN. DEV.	23,070	17,494	31,066	0	3,191
DAILY QUANTITY VARIANCE	532,243,645	306,026,169	965,082,889	0	10,180,707
DAILY HIGH	118,287	77,198	118,287	9,929	10,370
DAILY LOW	1,000	1,000	3,006	9,929	2,420
PERCENT DIFFERENCE FROM THE AVERAGE		-14.02%	65.84%	-57.89%	-79.28%

Table 3.14 UF Survey Seed and Mulch

12. cont. SEED AND MULCH
(SQUARE YARD)

	LOCAL CONDITIONS			TRAFFIC CONDITIONS		
	RURAL	URBAN	LIMITED	LIGHT	MEDIUM	HEAVY
NUMBER OF SAMPLES	44	14	0	7	29	22
TOTAL UNITS WORKED	1,275,136	92,357		186,967	916,364	264,162
TOTAL HOURS WORKED	356	92		49	245	153
AVERAGE HOURS WORKED/DAY	8.09	6.54		7.00	9.46	6.95
HOURLY STAN. DEV.	2.05	5.16		2.84	1.84	4.24
HOURLY VARIANCE	4.19	26.62		8.07	3.37	18.00
AVERAGE UNITS WORKED/DAY	28,980	6,597		26,710	31,599	12,007
DAILY QUANTITY STAN. DEV.	23,835	6,277		20,041	24,415	16,366
DAILY QUANTITY VARIANCE	568,122,548	39,398,934		401,653,136	596,083,473	267,840,286
DAILY HIGH	118,287	25,121		53,240	118,287	77,198
DAILY LOW	1,819	1,000		1,819	2,420	1,000
PERCENT DIFFERENCE FROM THE AVERAGE	22.92%	-72.02%		13.28%	34.02%	-49.07%

Table 3.14 cont.

12. cont. SEED AND MULCH
(SQUARE YARD)

FACTORS WHICH HAD AN EFFECT ON PRODUCTION

	WEATHER	TRAFFIC	MANPOWER OR EQUIP	UTILITY DELAYS	WORK PHASING	OTHER	NO FACTORS
NUMBER OF SAMPLES	21	20	0	0	[illegible]	[illegible]	[illegible]
TOTAL UNITS WORKED	450,553	324,199			447,327	251,006	304,757
TOTAL HOURS WORKED	133	128			106	87	115
AVERAGE HOURS WORKED/DAY	6.31	6.39			5.86	12.36	7.13
HOURLY STAN. DEV.	2.58	3.05			2.98	3.77	[illegible]
HOURLY VARIANCE	6.68	9.30			4.36	14.19	[illegible]
AVERAGE UNITS WORKED/DAY	21,455	16,210			24,385	35,858	19,047
DAILY QUANTITY STAN. DEV.	21,120	19,606			20,544	39,300	16,379
DAILY QUANTITY VARIANCE	4.46E+08	3.34E+08			4.22E+08	1.53E+09	2.68E+08
DAILY HIGH	77,198	77,198			58,401	118,287	66,317
DAILY LOW	1,000	1,000			1,000	3,006	1,564
PERCENT DIFFERENCE FROM THE AVERAGE	-9.00%	-31.25%			5.55%	52.09%	-19.21%

Table 3.14 cont.

12. SOD
(SQUARE YARD)

		PROJECT CATEGORY			
	ORIGINAL	RECONSTRUCTION	CONSTRUCTION	INTERSECTION	BRIDGE
NUMBER OF SAMPLES	139	108	21	4	6
TOTAL UNITS WORKED	250,010	169,330	66,256	4,213	10,156
TOTAL HOURS WORKED	1,176	860	232	28	57
AVERAGE HOURS WORKED/DAY	8.46	7.96	11.02	7.00	9.50
HOURLY STAN. DEV.	3.06	2.01	5.51	1.73	1.12
HOURLY VARIANCE	9.34	4.03	30.31	3.00	1.25
AVERAGE UNITS WORKED/DAY	1,799	1,568	3,155	1,055	1,693
DAILY QUANTITY STAN. DEV.	2,159	1,348	4,379	255	570
DAILY QUANTITY VARIANCE	4,660,558	1,816,688	19,179,139	64,816	324,450
DAILY HIGH	16,536	9,007	16,536	1,404	2,200
DAILY LOW	6	5	356	716	800
PERCENT DIFFERENCE FROM THE AVERAGE		-12.80%	75.41%	-41.37%	-5.89%

Table 3.15 UF Survey Sod

13. cont. SOD
(SQUARE YARD)

	LOCAL CONDITIONS			TRAFFIC CONDITIONS		
	RURAL	URBAN	LIMITED	LIGHT	MEDIUM	HEAVY
NUMBER OF SAMPLES	91	48	0	17	65	57
TOTAL UNITS WORKED	196,594	53,416		34,610	145,612	69,788
TOTAL HOURS WORKED	757	419		147	534	496
AVERAGE HOURS WORKED/DAY	8.32	8.73		8.65	8.21	8.69
HOURLY STAN. DEV.	1.89	4.46		2.30	1.85	4.12
HOURLY VARIANCE	3.56	19.92		5.29	3.41	16.99
AVERAGE UNITS WORKED/DAY	2,160	1,113		2,036	2,240	1,224
DAILY QUANTITY STAN. DEV.	2,523	841		2,051	2,771	886
DAILY QUANTITY VARIANCE	6,366,513	707,949		4,208,537	7,678,723	784,688
DAILY HIGH	16,536	4,000		9,007	16,536	4,000
DAILY LOW	6	98		418	6	175
PERCENT DIFFERENCE FROM THE AVERAGE	20.11%	-38.13%		13.19%	24.55%	-31.93%

Table 3.15 cont.

13. cont. SOD
(SQUARE YARD)

FACTORS WHICH HAD AN EFFECT ON PRODUCTION

	WEATHER	TRAFFIC	MANPOWER OR EQUIP	UTILITY DELAYS	WORK PHASING	OTHER	NO FACTORS
NUMBER OF SAMPLES	56	44	15	5	13	20	48
TOTAL UNITS WORKED	103,249	51,642	17,915	2,250	52,031	24,990	108,531
TOTAL HOURS WORKED	452	315	125	38	126	202	416
AVERAGE HOURS WORKED/DAY	8.06	7.15	8.30	7.60	6.61	10.08	3.66
HOURLY STAN. DEV.	2.04	2.20	1.26	0.80	2.61	5.98	1.99
HOURLY VARIANCE	4.14	4.82	1.59	0.64	6.33	35.31	3.95
AVERAGE UNITS WORKED/DAY	1,844	1,174	1,194	450	2,738	1,250	2,261
DAILY QUANTITY STAN. DEV.	2,800	1,003	853	161	4,542	785	1,746
DAILY QUANTITY VARIANCE	7,841,851	1,005,885	727,660	26,000	20,633,044	616,364	3,047,169
DAILY HIGH	16,536	3,822	3,185	700	16,536	2,679	9,007
DAILY LOW	175	99	200	200	430	6	98
PERCENT DIFFERENCE FROM THE AVERAGE	2.51%	-34.75%	-33.60%	-74.98%	52.25%	-30.53%	25.71%

Table 3.15 cont.

14. GUARDRAIL
(LINEAR FEET)

		PROJECT CATEGORY			
	ORIGINAL	RECONSTRUCTION	CONSTRUCTION	INTERSECTION	BRIDGE
NUMBER OF SAMPLES	52	40	6	0	6
TOTAL UNITS WORKED	18,970	15,301	2,126		1,543
TOTAL HOURS WORKED	397	301	62		34
AVERAGE HOURS WORKED/DAY	7.63	7.53	10.33		5.67
HOURLY STAN. DEV.	2.44	2.30	0.75		2.05
HOURLY VARIANCE	5.93	5.31	0.56		4.22
AVERAGE UNITS WORKED/DAY	365	383	354		257
DAILY QUANTITY STAN. DEV.	486	526	397		160
DAILY QUANTITY VARIANCE	235,886	277,030	157,977		25,693
DAILY HIGH	2,288	2,288	1,175		410
DAILY LOW	0	0	38		50
PERCENT DIFFERENCE FROM THE AVERAGE		4.86%	-2.87%		-29.53%

Table 3.16 UF Survey Guardrail

14. cont. GUARDRAIL
(LINEAR FEET)

	LOCAL CONDITIONS			TRAFFIC CONDITIONS		
	RURAL	URBAN	LIMITED	LIGHT	MEDIUM	HEAVY
NUMBER OF SAMPLES	35	17	0	4	22	26
TOTAL UNITS WORKED	14,378	4,592		3,200	6,894	8,376
TOTAL HOURS WORKED	278	119		34	169	195
AVERAGE HOURS WORKED/DAY	7.94	7.00		8.38	7.66	7.50
HOURLY STAN. DEV.	2.16	2.82		2.04	2.52	2.40
HOURLY VARIANCE	4.65	7.97		4.17	6.33	5.77
AVERAGE UNITS WORKED/DAY	411	270		800	313	341
DAILY QUANTITY STAN. DEV.	574	174		693	436	453
DAILY QUANTITY VARIANCE	329,263	30,321		480,938	189,957	205,121
DAILY HIGH	2,288	600		1,700	1,932	2,288
DAILY LOW	31	0		125	31	0
PERCENT DIFFERENCE FROM THE AVERAGE	12.61%	-25.95%		119.30%	-14.11%	-6.42%

Table 3.16 cont.

14. cont. GUARDRAIL
(LINEAR FEET)

	FACTORS WHICH HAD AN EFFECT ON PRODUCTION						
	WEATHER	TRAFFIC	MANPOWER OR EQUIP	UTILITY DELAYS	WORK PHASING	OTHER	NO FACTORS
NUMBER OF SAMPLES	11	18	12	8	4	0	26
TOTAL UNITS WORKED	5,838	3,325	1,425	1,900	1,525		11,332
TOTAL HOURS WORKED	88	131	80	64	36		212
AVERAGE HOURS WORKED/DAY	8.00	7.28	6.63	8.00	9.00		8.13
HOURLY STAN. DEV.	2.66	2.61	2.94	3.12	0.71		2.26
HOURLY VARIANCE	7.09	6.81	8.63	[illegible]	0.50		[illegible]
AVERAGE UNITS WORKED/DAY	531	185	119	238	381		436
DAILY QUANTITY STAN. DEV.	618	137	79	172	130		506
DAILY QUANTITY VARIANCE	381,591	18,794	6,211	29,648	16,392		255,309
DAILY HIGH	2,288	575	325	575	575		1,932
DAILY LOW	63	50	38	63	250		0
PERCENT DIFFERENCE FROM THE AVERAGE	45.49%	-49.36%	-67.45%	-34.90%	4.51%		19.47%

Table 3.16 cont.

15. REFLECTIVE PAVEMENT MARKERS
(EACH)

		PROJECT CATEGORY			
	ORIGINAL	RECONSTRUCTION	CONSTRUCTION	INTERSECTION	BRIDGE
NUMBER OF SAMPLES	57	46	3	2	1
TOTAL UNITS WORKED	35,708	29,312	5,737	593	66
TOTAL HOURS WORKED	354	289	50	13	2
AVERAGE HOURS WORKED/DAY	6.20	6.27	6.25	6.50	2.00
HOURLY STAN. DEV.	3.11	3.25	2.28	1.50	0.00
HOURLY VARIANCE	9.65	10.56	5.19	2.25	0.00
AVERAGE UNITS WORKED/DAY	626	637	717	297	66
DAILY QUANTITY STAN. DEV.	522	539	441	102	0
DAILY QUANTITY VARIANCE	272,800	290,588	194,881	10,302	0
DAILY HIGH	2,215	2,215	1,300	398	66
DAILY LOW	36	36	149	195	66
PERCENT DIFFERENCE FROM THE AVERAGE		1.72%	14.47%	-52.67%	-89.46%

Table 3.17 Reflective Pavement Markers

15. cont. REFLECTIVE PAVEMENT MARKERS
(EACH)

	LOCAL CONDITIONS			TRAFFIC CONDITIONS		
	RURAL	URBAN	LIMITED	LIGHT	MEDIUM	HEAVY
NUMBER OF SAMPLES	34	13	4	3	25	23
TOTAL UNITS WORKED	24,324	8,317	2,067	1,467	17,282	15,959
TOTAL HOURS WORKED	227	30	47	12	164	178
AVERAGE HOURS WORKED/DAY	6.68	4.21	11.63	4.00	6.56	6.12
HOURLY STAN. DEV.	2.73	2.23	0.41	2.16	2.61	3.46
HOURLY VARIANCE	7.47	4.98	0.17	4.67	6.83	11.93
AVERAGE UNITS WORKED/DAY	730	464	517	489	691	535
DAILY QUANTITY STAN. DEV.	537	489	270	412	502	542
DAILY QUANTITY VARIANCE	288,313	239,024	72,731	169,309	252,335	293,784
DAILY HIGH	2,029	2,215	957	1,033	1,800	2,215
DAILY LOW	36	56	223	36	88	56
PERCENT DIFFERENCE FROM THE AVERAGE	16.55%	-25.92%	-17.51%	-21.94%	10.35%	-6.65%

Table 3.17 cont.

15. CONT. REFLECTIVE PAVEMENT MARKERS
(EACH)

	FACTORS WHICH HAD AN EFFECT ON PRODUCTION						
	WEATHER	TRAFFIC	MANPOWER OR EQUIP	UTILITY DELAYS	WORK PHASING	OTHER	NO FACTORS
NUMBER OF SAMPLES	14	28	0	0	5	0	24
TOTAL UNITS WORKED	7,691	16,272			848		16,461
TOTAL HOURS WORKED	101	164			14		159
AVERAGE HOURS WORKED/DAY	7.18	5.86			2.80		6.56
HOURLY STAN. DEV.	3.78	3.62			0.75		2.55
HOURLY VARIANCE	14.27	13.09			0.56		6.49
AVERAGE UNITS WORKED/DAY	549	581			170		686
DAILY QUANTITY STAN. DEV.	503	582			88		480
DAILY QUANTITY VARIANCE	253,440	338,852			7,811		230,514
DAILY HIGH	2,029	2,215			300		1,800
DAILY LOW	56	36			56		88
PERCENT DIFFERENCE FROM THE AVERAGE	-12.31%	-7.23%			-72.93%		9.48%

Table 3.17 cont.

16. BREAKING AND COMPACTING CONCRETE
(SQUARE YARD)

	PROJECT CATEGORY				
	ORIGINAL	RECONSTRUCTION	CONSTRUCTION	INTERSECTION	BRIDGE
NUMBER OF SAMPLES	10	5	5	0	0
TOTAL UNITS WORKED	902	616	286		
TOTAL HOURS WORKED	86	36	50		
AVERAGE HOURS WORKED/DAY	8.60	7.20	10.00		
HOURLY STAN. DEV.	1.80	1.60	0.00		
HOURLY VARIANCE	3.24	2.56	0.00		
AVERAGE UNITS WORKED/DAY	90	123	57		
DAILY QUANTITY STAN. DEV.	83	91	58		
DAILY QUANTITY VARIANCE	6,861	8,234	3,317		
DAILY HIGH	228	228	167		
DAILY LOW	5	17	5		
PERCENT DIFFERENCE FROM THE AVERAGE		36.55%	-36.55%		

Table 3.18 UF Survey Breaking and Compacting Concrete

16. cont. BREAKING AND COMPACTING CONCRETE
(SQUARE YARD)

	LOCAL CONDITIONS			TRAFFIC CONDITIONS		
	RURAL	URBAN	LIMITED	LIGHT	MEDIUM	HEAVY
NUMBER OF SAMPLES	5	5	0	0	0	10
TOTAL UNITS WORKED	286	616				902
TOTAL HOURS WORKED	50	36				86
AVERAGE HOURS WORKED/DAY	10.00	7.20				8.60
HOURLY STAN. DEV.	0.00	1.60				1.80
HOURLY VARIANCE	0.00	2.56				3.24
AVERAGE UNITS WORKED/DAY	57	123				90
DAILY QUANTITY STAN. DEV.	58	91				83
DAILY QUANTITY VARIANCE	3,317	8,234				6,861
DAILY HIGH	167	228				228
DAILY LOW	5	17				5
PERCENT DIFFERENCE FROM THE AVERAGE	-36.55%	36.55%				0.00%

Table 3.18 cont.

16. cont. BREAKING AND COMPACTING CONCRETE
(SQUARE YARD)

	FACTORS WHICH HAD AN EFFECT ON PRODUCTION						
	WEATHER	TRAFFIC	MANPOWER OR EQUIP	UTILITY DELAYS	WORK PHASING	OTHER	NO FACTORS
NUMBER OF SAMPLES	0	5	0	5	0	0	0
TOTAL UNITS WORKED		516		236			
TOTAL HOURS WORKED		36		50			
AVERAGE HOURS WORKED/DAY		7.20		10.00			
HOURLY STAN. DEV.		1.60		0.00			
HOURLY VARIANCE		2.56		0.00			
AVERAGE UNITS WORKED/DAY		123		57			
DAILY QUANTITY STAN. DEV.		91		58			
DAILY QUANTITY VARIANCE		8,234		3,317			
DAILY HIGH		228		167			
DAILY LOW		17		5			
PERCENT DIFFERENCE FROM THE AVERAGE		36.55%		-36.55%			

Table 3.18 cont.

17. COMPRESSION SEAL REPLACEMENT
(LINEAR FEET)

	PROJECT CATEGORY				
	ORIGINAL	RECONSTRUCTION	CONSTRUCTION	INTERSECTION	BRIDGE
NUMBER OF SAMPLES	3	1	2	0	0
TOTAL UNITS WORKED	424	186	238		
TOTAL HOURS WORKED	26	6	20		
AVERAGE HOURS WORKED/DAY	8.67	6.00	10.00		
HOURLY STAN. DEV.	1.89	0.00	0.00		
HOURLY VARIANCE	3.56	0.00	0.00		
AVERAGE UNITS WORKED/DAY	141	186	119		
DAILY QUANTITY STAN. DEV.	32	0	5		
DAILY QUANTITY VARIANCE	1,014	0	25		
DAILY HIGH	186	186	124		
DAILY LOW	114	186	114		
PERCENT DIFFERENCE FROM THE AVERAGE		31.60%	-15.80%		

Table 3.19 UF Survey Compression Seal Replacement

17. cont. COMPRESSION SEAL REPLACEMENT
(LINEAR FEET)

	LOCAL CONDITIONS			TRAFFIC CONDITIONS		
	RURAL	URBAN	LIMITED	LIGHT	MEDIUM	HEAVY
NUMBER OF SAMPLES	2	1	0	0	0	3
TOTAL UNITS WORKED	238	136				424
TOTAL HOURS WORKED	20	6				25
AVERAGE HOURS WORKED/DAY	10.00	6.00				8.67
HOURLY STAN. DEV.	0.00	0.00				1.89
HOURLY VARIANCE	0.00	0.00				3.56
AVERAGE UNITS WORKED/DAY	119	136				141
DAILY QUANTITY STAN. DEV.	5	0				32
DAILY QUANTITY VARIANCE	25	0				1,014
DAILY HIGH	124	136				186
DAILY LOW	114	186				114
	-15.80%	31.60%				0.00%

Table 3.19 cont.

17. cont. COMPRESSION SEAL REPLACEMENT
(LINEAR FEET)

FACTORS WHICH HAD AN EFFECT ON PRODUCTION

	WEATHER	TRAFFIC	MANPOWER OR EQUIP	UTILITY DELAYS	WORK PHASING	OTHER	NO FACTORS
NUMBER OF SAMPLES	2	1	0	0	0	0	0
TOTAL UNITS WORKED	238	186					
TOTAL HOURS WORKED	20	6					
AVERAGE HOURS WORKED/DAY	10.00	6.00					
HOURLY STAN. DEV.	0.00	0.00					
HOURLY VARIANCE	0.00	0.00					
AVERAGE UNITS WORKED/DAY	119	186					
DAILY QUANTITY STAN. DEV.	5	0					
DAILY QUANTITY VARIANCE	25	0					
DAILY HIGH	124	186					
DAILY LOW	114	186					
PERCENT DIFFERENCE FROM THE AVERAGE	-15.80%	31.60%					

Table 3.19 cont.

CHAPTER 4

UNIVERSITY OF FLORIDA SURVEY

RESULTS COMPARED TO OTHER STUDIES

A. Introduction.

Two additional surveys were conducted to acquire as much data as possible concerning highway construction productivity rates. The first survey initiated by UF was an investigation of productivity rates used by the other state highway agencies. A survey was sent to the 50 state DOT's with 37 responding and providing information concerning methods for estimating contract time and the associated productivity rates. The second survey entailed contacting private contractors that specialize in highway construction and contract with FDOT. Discussions were conducted with four contractors to obtain their productivity rates. These two surveys were conducted and coordinated by Ralph Ellis.

B. Summary Of Surveys.

The combined survey summary is tabulated in table 4.1. The summary includes the results from the data that was received from all three surveys (UF Productivity, UF State DOT, and UF Contractor). There are additional work activities included in this table that are not included in the UF survey, because of the variety of information received. The summary shows the data collected by source and the recommended production rate to use on FDOT construction projects. The tables and recommendations were taken from the "Final Report, Establishing Contract Durations Based On Production Rates For FDOT Construction Projects", authored by Dr. Zohar Herbsman, and Mr. Ralph Ellis, dated June 27, 1988.

The three surveys provided a broad base to obtain the required information to make a knowledgeable recommendation to the FDOT concerning the standard productivity rates they use to determine contract duration. Based on the information obtained from the surveys four additional standard work activities are recommended.21 The recommendations are to add Highway Lighting, Fence and Signalization as additional work activities, and divide Excavation into two activities. The activities are excavation by using scrapers and excavation by using trucks. Table 4.2 contains the recommended new rates to be used by FDOT.22

DATA COLLECTION SUMMARY SHEET

Work Item: Move-In

Description: Mobilization in Preparation for Commencing Work

Source	Production Rate (days)	Comments
FDOT	15 - 25	15 - normal; 25 - normal
UF 1979 Report	7	
Arkansas DOT	5	
Maryland DOT	10	
Michigan DOT	10	
Minnesota DOT	8	
New Jersey DOT	10	
Oklahoma DOT	20 -20	
Wyoming DOT	5 - 10	
Contractor A	15	
Contractor B	15	
Contractor C	15	
Contractor D	4	

Data Summary

FDOT 15 days
UF Survey 7 days

State DOT's Mean 10
Contractor Mean 12

Investigator's Comments: Unless the project is unique, two weeks appears to be adequate time for mobilization.

Indicated Production Rate: 15 days

Table 4.1 Combined Survey Summary

DATA COLLECTION SUMMARY SHEET

Work Item	Description
Clear and Grub	Clearing and Removal of Grass, Brush and Trees

Source	Production Rate(acres/day)	Comments
FDOT	1 - 10	not to exceed 20 days; grading time will govern after 20 days
UF Survey	2.3	
Arkansas DOT	1.25 - 2.5	10, laarge jobs
Lousiana DOT	1.5	
Michigan DOT	2	
New Jersey DOT	4 - 10	4 - construction and reconstruction 10 - widening and resurfacing
North Carolina DOT	1/4 - 10	1 - 10, major projects; 1 - 8, grading + paving projects 1/4 - 1, small rural - urban projects
Wisconsin DOT	2.5	
Colorado DOT	3.0	
Contractor A	5	
Contractor B	2.0	0.3 for heavy; 6.0 for light
Contractor C	.75 - 5	.75 for urban; 5.0 for interstate
Contractor D	2.5	

Data Summary

FDOT 1 - 10
UF Survey 2.3

State DOT's Mean 3.3
Contractor Mean 3.1

Investigator's Comments: rate for light clearing on large, open access projects is up to 10 acres day.
rate on heavy clearing or on small urban jobs may be only 1 acre day.

Indicated Production Rate: 3.0 acres/day for medium clearing under average conditions

Table 4.1 cont.

DATA COLLECTION SUMMARY SHEET

Work Item	Description
Excavation	General Excavation (cut to fill) Scrapper Operation

Source	Production Rate(acres/day)	Comments
FDOT	use curves	1,800, small jobs 0 - 10,000 cy 27,500, large jobs over 100,000 cy
UF Survey	1,044	
UF 1979 Report	2,000 - 5,000	3,000, for 3,500 ft haul 4,000 for 2,000 ft haul
Lousiana DOT	1,000 - 3,000	1,000, urban 3,000, rural
Michigan DOT	800 - 12,000	800 + embankment; 12,000 freeway 1,000, bridge; 5,000, reconstruction
Minnesota DOT	2,000 - 10,000	9,000, scrapper; 5,500, truck
New Jersey DOT	500 - 2,000	500, reconstruction; 2,000 construction
North Carolina DOT	100 - 8,000	300, small jobs; 4,000, grading + paving job 7,000, major project
North Dakota DOT	1,200 - 12,800	1,200, 0 - 20,000 cy; 6,400, 100,000 - 250,000 cy; 9,600, 500,000 - 1,000,000 cy; 12,800 over 1 million cy
Oklahoma DOT	3,000 - 10,000	3,000, 0 - 200,000 cy; 5,000, 500,000 - 600,000 cy; 6,000, over 700,000 cy; 10,000, extra laarge jobs
Wisconsin DOT	300 - 5,000	
Wyoming DOT	500 - 10,000	rock excavation 2,000 - 3,000 cy/day; solid rock excavation 500 cy/day
Pennsylvania DOT	2,500	based on 3,000' - 4,000' haul for less than 2,000' haul use 4,500 cy/day
Colorado DOT	2,300	
Contractor A	10,000	
Contractor B	1,400 - 11,000	depends on number of units and haul distance
Contractor C	3,500	for balance cut + fill, grading time controls, 5,000 sy/day
Contractor D	4,000	maximum production on large jobs 11,000 cy/day

Data Summary

FDOT 1,800 - 32,500
UF Survey 1,044

State DOT's Mean 1,300 - 4,300 - 8,100
Contractor Mean 5,900

Investigator's Comments:

	low	ave.	high
Indicated Production Rate:	1,400 -	5,600 -	11,200 cy/day

Table 4.1 cont.

DATA COLLECTION SUMMARY SHEET

Work Item	Description
Truck Haul	Excavation which requires Truck Hauling (over 1 mile hauls)

Source	Production Rate (cy/day)	Comments
Minnesota DOT	5,500	
Colorado DOT	2,300	
Contractor A	6,000	
Contractor B	900 - 7,000	depends on number of units
Contractor C	2,400	
Contractor D	2,700	

FDOT
UF Survey

Data Summary

State DOT's Mean 3,900
Contractor Mean 3,800

Investigator's Comments: separate item for truck haul excavation should be added

	low	ave.	high
Indicated Production Rate:	900	3,000	7,500

Table 4.1 cont.

DATA COLLECTION SUMMARY SHEET

Work Item	Description
Base Course	Base Construction, Sand-Clay, Lime Rock, Lime Rock Stabilized, Shell Stabilized and Soil Cement

Source	Production Rate(sy/day)	Comments
FDOT	use curves	1,000, 0 - 10,000 sy 4,500, over 10,000 sy
UF Survey	1,690	
UF 1979 Report	800 - 2,000	800 - 12" base; 1,200 - 8" base 2,000 - 6" base
Arkansas DOT	1,800 - 3,000	1,800, small project 12" base 3,000, large project 12" base
Lousiana DOT	3000 - 4,500	3,000 - 4,500 - non stabilized
North Carolina DOT	600 - 1,400	sand asphalt
Oklahoma DOT	500 - 2,000	0 - 30,000 sy, use 500 sy/day; 30,000 - 60,,000 sy, use 1,000 60,000 - 150,000 sy, use 1,500; 150,000 +, use 2,000
Wisconsin DOT	4,000	
Wyoming DOT	2,000 - 12,800	
Colorado DOT	2,000	for small jobs reduce to 1,000 sy/day
Contractor A	1,800	
Contractor B	900 - 1,800	1,800 - for single lift; 900 - for double lift
Contractor C	1,200 - 2,500	2,500 - single lift; 1,200 - double llift
Contractor D	5,200	5,200 - for single lift; 2,600 - for double llift

Data Summary

FDOT 4,500
UF Survey 1,690

State DOT's Mean 1,450 - 2,800 - 4,150
Contractor Mean 2,800 for single lift

Investigator's Comments: rate is dependent upon the number of lifts required

Indicated Production Rate: 1,800 sy/day for single lift; 900 sy/day for double lift

Table 4.1 cont.

DATA COLLECTION SUMMARY SHEET

Work Item	Description
Stabilized Road Bed	General Stabilization

Source	Production Rate (sy/day)	Comments
FDOT	5,000	not to exceed 10 days
UF Survey	4,636	
UF 1979 Report	1,000	
Arkansas DOT		5 days - small project; 600 tons/day - large project
Louisiana DOT	8,000	
Contractor A	2,000	
Contractor B	3,500	
Contractor C	2,500	

Data Summary

FDOT 5,000
UF Survey 4,636

State DOT's Mean 3,000
Contractor Mean 2,700

Investigator's Comments:

Indicated Production Rate: 4,500 sy/day

Table 4.1 cont.

DATA COLLECTION SUMMARY SHEET

Work Item	Description
Surface Treatment	Aggregate with Asphalt Treatment

Source	Production Rate (cy/day)	Comments
FDOT	200	
UF Survey	~~401~~ 653	
Contractor A		not a current procedure
Contractor B	200	
Contractor C		not a current procedure
Contractor D		not a current procedure

Data Summary

FDOT 200
UF Survey ~~401~~ 653

State DOT's Mean
Contractor Mean 200

Investigator's Comments: this activity is apparently not common

Indicated Production Rate: 400 cy/day

Table 4.1 cont.

DATA COLLECTION SUMMARY SHEET

Work Item: Concrete Pavement

Description: Cement Concrete Pavement

Source	Production Rate(sy/day)	Comments
FDOT	5,000	
UF Survey	81	3 samples for a total of 15 days
UF 1979 Report	6,800 - 9,600	6,800 - 9" pavement; 7,800 - 8" pavement 9,600 - 6" pavement
Lousiana DOT	2,000	
Michigan DOT	4,000	add 5 days for cure time
Minnesota DOT	2,000 - 10,000	2,000 non-standard width; 10,000 standard width
New Jersey DOT	225 - 2,500	225 - intersection; 750 - widening; 1,000 - reconstruction; 2,500 - construction
North Carolina DOT	1000 - 5,000	1,000 - 1,500 tapors; 3,000 - 5,000 all projects
Oklahoma DOT	400 - 2,000	400 - municipal; 800 - 1,000 rural; 2,000 - large 4 lane
Wisconsin DOT	1,200 - 5,000	1,200 - urban; 5,000 - rural
Colorado DOT	4,500	for very large jobs, up to 10,000 sy day
Contractor A	1,000 - 5,000	1,000 - for widening; 5,000 - for large production jobs
Contractor B	2,000 - 4,000	2,000 - is average; 4,000 - for large jobs with central plant

Data Summary

FDOT 5,000
UF Survey 81

State DOT's Mean 965 - 2045 - 4900
Contractor Mean 1,000 - 2,000 - 4,500

Investigator's Comments:

Indicated Production Rate: 2,000 sy/day for average jobs.
for jobs exceeding 25,000 sy total, use rate of 4,000 sy/day

Table 4.1 cont.

DATA COLLECTION SUMMARY SHEET

Work Item	Description
Mill Existing Pavement	Milling of Existing Pavement

Source	Production Rate(sy/day)	Comments
FDOT	4,000	20 days maximum
UF Survey	12,244	
Lousiana DOT	5,000 - 10,000	
Minnesota DOT	6,000 - 15,000	6,000 - *urban reconstruction* 15,000 - large project
New Jersey DOT	1,000 - 25,000	25,000- reconstruction, widening, resurfacing 1,000 - intersection
Colorado DOT	6,000	
Contractor A	10,000	
Contractor C	7,000	
Contractor D	6,000	

Data Summary

FDOT 4,000
UF Survey 12,244

State DOT's Mean 4,500 - 4,500 - 16,700
Contractor Mean 7,700

Investigator's Comments: one milling unit produces an average of 6,000 sy/day

Indicated Production Rate: 6,000 sy/day for average jobs

Table 4.1 cont.

DATA COLLECTION SUMMARY SHEET

Work Item	Description
Plant Mix	Asphaltic Concrete Courses

Source	Production Rate (tons/day)	Comments
FDOT	use curves	approx. 1,000 tons/day
UF Survey	~~887~~ 720	
UF 1979 Report	1,000	
Arkansas DOT	600	5 days small project 600 tons/day large project
Louisiana DOT	500-1,000	500-800, overlay; 1,000 large project
Minnesota DOT	1,500-7,400	2,400 - base course; 2,000 - binder 2,000 - wearing course >1"; 1,500 - wearing course <1"
New Jersey DOT	50-1,000	50 - intersection; 750 - reconstruction 1,000 - construction, widening, resurfacing
North Carolina DOT	200-1,500	200-500 small version project; 200-600 small rural widening project 300-1,000 grading/paving project; 800-1600 major projects
North Dakota DOT	600-2,000	Size of Job / Not Bit. / Recycled Bit. 0-20,000 tons / 800 tons/day / 600 tons/day 20,000-40,000 / 1,200 / 900 40,000-80,000 / 1,800 / 1,350 80,000+ / 2,000 / 1,500
Oklahoma DOT	250-1,000	Size of Job 250 / 0-15,000 500 / 15,000-30,000 750 / 30,000-75,000 1,000 / 75,000+
Wisconsin DOT	500 -1,000	500 - urban 1,000-rural
Wyoming DOT	1,500 - 2,000	
Colorado DOT	500	For large projects up to 1,000 tons/day
Contractor A	900 - 1,000	1,500 for large interstate jobs
Contractor B	400 - 600	
Contractor C	450	1200 for large interstate jobs
Contractor D	450	

Data Summary

FDOT 1,000
UF Survey ~~857~~ 720

State DOT's Mean 640 - 822 - 1,550
Contractor Mean 590

Investigator's Comments:

Indicated Production Rate: 500 ton/day for everage projects up to 1200 tons/day for large interstate jobs.

Table 4.1 cont.

DATA COLLECTION SUMMARY SHEET

Work Item	Description
Sewer Pipe	Concrete Drainage Pipes

Source	Production Rate(LF/day)	Comments
FDOT	100 - 400	for municipal project: includes pipe, inlets, manholes, etc.
UF Survey	68	
Lousiana DOT	200	pipe less than 36"
Michigan DOT	400 - 120	120(0 - 14ft up to 60"), 80(0 - 14ft over 60") 60(14ft plus), 40(jacked in place)
Minnesota DOT	150 - 300	150 pipe greater than 30"; 300 pipe less than 24"
New Jersey DOT	50 - 200	50 - widening + intersection; 100 - reconstruction; 200 - construction
North Carolina DOT	50 - 300	100 - 300 major project; 100 - 200 small rural + widening projects; 50 - 200 small urban project
Wisconsin DOT	100	
Wyoming DOT	200	
Pennsylvania DOT	60 - 150	84" pipe use 60 LF/ day; 24" pipe use 150 LF day
Contractor A	100 - 110	
Contractor B	100	
Contractor C	100	60 LF day for urban jobs

Data Summary

FDOT 100 - 400
UF Survey 68

State DOT's Mean 73 - 157 - 214
Contractor Mean 102

Investigator's Comments:

Indicated Production Rate: 100 LF/day

Table 4.1 cont.

DATA COLLECTION SUMMARY SHEET

Work Item	Description
Curb and Gutter	Concrete Curb and Gutter Section Including Apparent Structures

Source	Production Rate(LF/day)	Comments
FDOT	300 - 700	
UF Survey	335	
UF 1979 Survey	1,000	
Michigan DOT	2,500	add 5 days cure time
Minnesota DOT	2,000	
New Jersey DOT	200 - 500	200 - intersection; 300 - resurface; 400 - widening; 400 - reconstruction; 500 - construction
North Carolina DOT	100 - 1,000	500 - 1,000 major project; 100 - 500 grading + paving project 100 - 300 small urban rural project
Wisconsin DOT	500	
Wyoming DOT	500	
Contractor A	300 - 1,000	300 for hand formed; 1,000 for machine formed
Contractor B	300	200 possible for straight runs but inlet and openings reduce rate
Contractor C	1,200	400 for hand formed jobs

Data Summary

FDOT 300 - 700
UF Survey 335

State DOT's Mean 1067
Contractor Mean 350 - 725 - 1,100

Investigator's Comments: The number of inlets and openings will effect the production rate

Indicated Production Rate: 300 - 1,000 LF/day

Table 4.1 cont.

DATA COLLECTION SUMMARY SHEET

Work Item: Sidewalk

Description: Cement Concrete Sidewalk

Source	Production Rate(sy/day)	Comments
FDOT	500	
UF Survey	130	
Michigan DOT	75 - 225	75 - patching; 225 - construction
Minnesota DOT	275	
New Jersey DOT	100 - 225	
Wisconsin DOT	500	100 - intersection; 150 - resurface; 175 - widening; 225 - construction
Wyoming DOT	100	
Contractor A	200	
Contractor B	300	
Contractor C	300 - 700	

Data Summary

FDOT 500
UF Survey 130

State DOT's Mean 238
Contractor Mean 333

Investigator's Comments:

Indicated Production Rate: 300 sy/day

Table 4.1 cont.

DATA COLLECTION SUMMARY SHEET

Work Item	Description
Seeding	Blown Seed Mulch

Source	Production Rate(sy/day)	Comments
FDOT	15,000	
UF Survey	23,577	
Michigan DOT	48,400	75 - patching; 225 - construction
Minnesota DOT	48,400	
New Jersey DOT	10,000	
North Carolina DOT	5,000 - 15,000	5,000 - 15,000 major projects; 5,000 - 10,000 small rural or urban projects
Wisconsin DOT	20,000	
Wyoming DOT	21,500	
Pennsylvania DOT	14,500	
Contractor A	1,500 - 12,000	12,000 for flat area; 1,500 for slopes
Contractor B	1,300 - 15,000	15,000 for flat area; 1,500 for slopes
Contractor C	10,000	
Contractor D	60,000	

Data Summary

FDOT 15,000
UF Survey 23577

State DOT's Mean 24,700
Contractor Mean 24,250

Investigator's Comments:

Indicated Production Rate: 23,500 sy/day

Table 4.1 cont.

DATA COLLECTION SUMMARY SHEET

Work Item	Description
Soding	Placement of Grass Sod

Source	Production Rate(sy/day)	Comments
UF Survey	1,800	
Michigan DOT	2,500	
Minnesota DOT	2,500	
Wyoming DOT	500 - 1,000	
Contractor C	1,000	
Contractor D	1,750	

Data Summary

FDOT
UF Survey 1,800

State DOT's Mean 1,438
Contractor Mean 1,375

Investigator's Comments:

Indicated Production Rate: 1,500 sy

Talbe 4.1 cont.

DATA COLLECTION SUMMARY SHEET

Work Item	Description
Guardrail	Installation of Guardrail Section

Source	Production Rate(LF day)	Comments
FDOT	1500	when significant part of project
UF Survey	364	
Lousiana DOT	500 - 1,000	
Maryland DOT	1,000	
Michigan DOT	750	
Minnesota DOT	750	
North Carolina DOT	50 - 1,500	500 - 800. small urban project; 100 - 500. small rural widening project. 500 - 1,500 major paving projects; 300 - 500 grading paving project
Colorado DOT	700	

Data Summary

FDOT 1500
UF Survey 364

State DOT's Mean 758
Contractor Mean

Investigator's Comments:

Indicated Production Rate: 300 - 1,500 LF day depending on quantity involved

Table 4.1 cont.

DATA COLLECTION SUMMARY SHEET

Work Item	Description
Breaking and Compacting Existing Concrete Pavement	Reseating Existing Pavement

Source	Production Rate(sy/day)	Comments
FDOT	5,000	
UF Survey	85	
Contractor D	10,000 - 15,000	

Data Summary

FDOT 5,000
UF Survey 85

State DOT's Mean
Contractor Mean 12,500

Investigator's Comments: UF survey sample may have been too small to make a resonable estimate

Indicated Production Rate: 5,000 sy/day

Table 4.1 cont.

DATA COLLECTION SUMMARY SHEET

Work Item	Description
Compression Seal Replacement	Replacement of Compression Seal

Source	Production Rate(ft/day)	Comments
FDOT	30 - 30	use 40 for zero LF or more
UF Survey	141	

Data Summary

FDOT 30
UF Survey 141

State DOT's Mean
Contractor Mean

Investigator's Comments:

Indicated Production Rate: 100 LF/day

Table 4.1 cont.

DATA COLLECTION SUMMARY SHEET

Work Item

Reflective Pavement Markers

Description

Installation of Reflective Markers

Source	Production Rate	Comments
FDOT	500 - 1,000	500 (0-20,000 ea0 1,000 (20,000 + ea)
UF Survey	626	
Lousiana DOT	1,000 - 2,000	1,000 - Traffic Present 2,000 - No Traffic

Data Summary

FDOT 500 - 1,000
UF Survey 626

State DOT's Mean 1,500
Contractor Mean

Investigator's Comments:

Indicated Production Rate: 500 - 1,000 per day depending on traffic and quantity involved

Table 4.1 cont.

DATA COLLECTION SUMMARY SHEET

Work Item	Description
Signalization	Installation of Intersection Signalization Equipment

Source	Production Rate	Comments
Minnesota DOT	15 days/intersection	does not include delivery time
New Jersey DOT	10 days/intersection	does not include delivery time

Data Summary

FDOT		State DOT's	Mean 12.5
UF Survey		Contractor	Mean

Investigator's Comments: procurement time should be figured separately

Indicated Production Rate: 15 days per intersection

Table 4.1 cont.

DATA COLLECTION SUMMARY SHEET

Work Item	Description
Fence	Installation Chain-Link Fencing

Source	Production Rate(ly/day)	Comments
Lousiana DOT	500 - 1,000	
Michigan DOT	500 - 1,200	500 woven wire, 1200 chain link
Minnesota DOT	2,000 - 4,000	2,000 woven wire, 1200 chain link
New Jersey DOT	400	chainllink
North Carolina DOT	300 - 2,000	1,000 - 2,000 - major project; 500 - 1,000 - grading/ paving project: 300 - 500 - small rural urban project
Wisconsin DOT	500	woven wire + chain link
Wyoming DOT	70 - 2,000	2.000 - ??/w fence. 640 - span force, 70 - 100 - screen fence. 1.00 - 1.500 - filter fabric

FDOT UF Survey	Data Summary	State DOT's Mean 1065 Contractor Mean

Investigator's Comments:

Indicated Production Rate: 1,200 LF/day on large quantity major projects
500 LF/day on small urban or rural projects

Tab;e 4.1 cont.

DATA COLLECTION SUMMARY SHEET

Work Item
Lighting

Description
Installation of Highway Lighting

Source	Production Rate	Comments
Michigan DOT	6 standards/day	
New Jersey DOT	4 standards/day	

FDOT
UF Survey

Data Summary

State DOT's Mean 5 standards/day
Contractor Mean

Investigator's Comments: procurement time should be figured separately

Indicated Production Rate: 5 standards/day

Table 4.1 cont.

Guidelines for Estimating Production Rates

1.	General Time (Move in, time prior to commencing work)	15 days	Normally
2.	Clearing and Grubbing	3/4 acre/day	Small quantity jobs
		3 acre/day	Medium clearing, average quantity
		10 acre/day	Light clearing, large quantity
3.	Excavation (Regular, Scrapper)	1400 cy/day	Small quantity jobs under 100,000 cy
		5600 cy/day	Medium quantity jobs 100,000 - 300,000 cy
		11200 cy/day	Large quantity jobs over 300,000 cy
4.	Excavation (Truck Haul)	900 cy/day	Small quantity jobs under 100,000 cy
		3800 cy/day	Medium quantity jobs 100,000 - 300,000 cy
		7500 cy/day	Large quantity jobs over 300,000 cy
5.	Stabilized Roadbed	4500 sy/day	Normal
6.	Bases Sand-Clay, Limerock, Limerock stabilized, Shell stabilized and Soil Cement bases	900 sy/day	Double lift installations
		1800 sy/day	Single lift installations

Table 4.2 Recommended Productivity Rates For FDOT

7.	Surface Treatment	400 cy/day	Normal
8.	Cement Concrete (Concrete Pavement)	2000 sy/day	Average quantity jobs
		4000 sy/day	Large quantity jobs over 25,000 cy
9.	Milling Existing Pavement	6000 sy/day	Average jobs (Note: This rate is achieved with one machine. If job quantities justify, more than one machine may be appropriate.)
10.	Plant Mixed Surfaces	500 Tn/day	Average jobs
		Up to 1200 Tn/day	Large quantity, Interstate jobs
11.	Storm Sewers	60 LF/day	Large pipe, urban jobs (84 in)
		100 LF/day	Average
		150 LF/day	Small pipe (24 in)
12.	Curb and Gutter	300 LF/day	Small quantity jobs, frequent openings and inlets
		1000 LF/day	Large quantity jobs, long straight runs
13.	Sidewalk	300 sy/day	Average jobs, depending on quantity and width

Table 4.2 cont.

14. Seed Mulch	23500 sy/day	Average jobs, flat surfaces
15. Grass Sod	1500 sy/day	Average jobs, flat surfaces
16. Guardrails	300 LF/day 1500 LF/day	Small quantity jobs Large quantity jobs
17. Compression Seal Replacement	100 LF/day	Normal
18. Breaking and Compacting Existing Concrete Pavement	5000 sy/day	Normal
19. Reflective Pavement Markers	500 Ea/day 1000 Ea/day	Small quantity, heavy traffic Large quantity, normal traffic
20. Signalization	15 days/inter-section	Normal (Procurement time not included.)

Table 4.2 cont.

21.	Highway Lighting	5 standards/ day	Normal (Procurement time not included.)
22.	Fence	500 LF/day	Small quantity, urban jobs
		1200 LF/day	Large quantity jobs
23.	Bridges	Use FDOT Tables and Charts for estimating work days required for bridges.	
24.	Utility Operations	Refer to Utility agreements.	
25.	Procurement of Critical Items	Consult industry sources for confirmations of current delivery times.	

Table 4.2 cont.

CHAPTER 5

SUMMARY AND CONCLUSIONS

A. Summary.

The basic definition of productivity, Output / Input, can be modified any number of ways to provide a meaningful relationship between the effort put into a task and the gains received from the effort. In the construction industry the most common way to measure productivity is unit output per man-hour; however, due to the uniqueness of the FDOT requirements for using productivity rates to determine contract duration, a productivity rate of unit output per day was used in the report. This daily productivity rate is independent of the contractor's crew size and the number of hours the contractor works per day.

Accurate measurement of productivity rates have become possible as a result of technological advances. Earlier in history it was not necessary, nor was it possible to precisely measure productivity. However, due to our increasingly complexity of the construction industry and the growing number of court actions, it has become imperative to measure productivity accurately. An accurate measurement of productivity gives the owner or contractor the confidence and ability to plan, organize, and control the manpower and resources available. Without an accurate measurement of productivity the owner or contractor could easily flounder in their attempt to control the construction contract.

The FDOT recognized the importance of knowing the accuracy of the productivity rates they use to determine the contract duration on highway construction contracts. Three surveys were completed by UF to provide the FDOT an updated and hopefully accurate representation of the actual productivity rates that are being achieved in the field by contractors. This report covers the survey that measured the actual productivity rates being achieved by the highway construction contractors here in Florida. This survey was sent to all FDOT Resident Engineers so they could measure the construction site productivity of 17 of the major work activities that are used to determine contract duration.

B. Conclusion.

An essential part of every highway construction project is the section which specifies the contract time allowed for the project.23 For the FDOT selection of the correct standard productivity rate for each work activity is the key to an acceptable estimate of contract time. The standard productivity rates for highway construction presented in this report should assist the FDOT in estimating a more predictable project contract duration (see table 4.2).

There are many factors in the survey that were measured to determine their overall affect on productivity. When using the standard productivity rates the FDOT Estimating Engineer must use his own engineering judgement, and modify the productivity rates to account for any factors that could inhibit the progress of the highway construction contractor. The engineer's knowledge of the factors that affect highway construction productivity can have a direct impact on the length of time given a contractor to complete a project.

APPENDIX A

UNIVERSITY OF FLORIDA SURVEY QUESTIONNAIRE

COLLEGE
OF
ENGINEERING

UNIVERSITY OF FLORIDA

GAINESVILLE, FLORIDA 32611
AREA CODE 904 PHONE 392-0933

DEPARTMENT OF CIVIL ENGINEERING

SPECIAL RESEARCH PROJECT
for
FLORIDA DEPARTMENT OF TRANSPORTATION

GENERAL INSTRUCTIONS

1. Select at least three projects. Try to pick different types of jobs such as new construction vs. reconstruction. Also, try to select jobs with different locations such as urban vs rural.

2. The information required consist of one page of general information about the project and one survey page for each different work activity. (Additional forms have been enclosed for the EXCAVATION category because it may be that a single project will involve more than one type of excavation.)

3. Field engineers should record contractor production quantities for all of the work items which are included in the project.

4. Return the forms as soon as they are completed to:

UNIVERSITY OF FLORIDA
DEPARTMENT OF CIVIL ENGINEERING
346 WEIL HALL
GAINESVILLE, FLORIDA 32611
ATTN: RALPH D. ELLIS, JR.

IF YOU HAVE ANY QUESTIONS OR NEED ANY ADDITIONAL INFORMATION PLEASE, TELEPHONE:

RALPH D. ELLIS, JR.
(904) 392-1085
OR
622-1085 SUNCOM

COLLEGE
OF
ENGINEERING

UNIVERSITY OF FLORIDA

GAINESVILLE, FLORIDA 32611
AREA CODE 904 PHONE 392-0933

DEPARTMENT OF CIVIL ENGINEERING

SPECIAL RESEARCH PROJECT
for
FLORIDA DEPARTMENT OF TRANSPORTATION

PROJECT GENERAL INFORMATION
(Please, see instructions on reverse side.)

1. PROJECT TITLE: ______________________________

2. STATE PROJECT JOB NO.: ______________________

3. TOTAL CONTRACT PRICE OF THE JOB: $ ______________

4. THIS PROJECT WOULD BE CATEGORIZED AS:

   ___ RECONSTRUCTION OF AN EXISTING ROAD
   ___ CONSTRUCTION OF A NEW ROAD
   ___ IMPROVEMENTS TO AN INTERSECTION
   ___ SIGNALIZATION
   ___ BRIDGE

   OTHER ______________________________

5. THIS PROJECT IS LOCATED IN ______________ COUNTY.

6. LOCAL CONDITIONS:

   ___ RURAL
   ___ URBAN
   ___ LIMITED ACCESS ROAD (INTERSTATE)

7. TRAFFIC CONDITIONS:

   ___ LIGHT
   ___ MEDIUM
   ___ HEAVY

8. FDOT RESIDENT ENGINEER ______________ DATE: ________

COLLEGE
OF
ENGINEERING

UNIVERSITY OF FLORIDA

GAINESVILLE, FLORIDA 32611
AREA CODE 904 PHONE 392-0933

DEPARTMENT OF CIVIL ENGINEERING

SPECIAL RESEARCH PROJECT
for
FLORIDA DEPARTMENT OF TRANSPORTATION

FIELD OBSERVATIONS
(Please, see instructions on reverse side.)

WORK ACTIVITY: **CLEARING** and **GRUBBING**

1. STATE PROJECT JOB NO.: ______________________________

2. TOTAL QUANTITY OF WORK IN THE JOB: ____________ acres

3. OBSERVED PRODUCTION QUANTITIES:

DATE: __________ QUANTITY: __________ acres NO. HOURS WORKED: __________
DATE: __________ QUANTITY: __________ acres NO. HOURS WORKED: __________
DATE: __________ QUANTITY: __________ acres NO. HOURS WORKED: __________
DATE: __________ QUANTITY: __________ acres NO. HOURS WORKED: __________
DATE: __________ QUANTITY: __________ acres NO. HOURS WORKED: __________

4. TYPE OF CLEARING AND GRUBBING WORK:

___ light : grass and scattered brush
___ medium : brush and scattered trees
___ heavy : heavy brush and large trees

5. FACTORS WHICH HAD AN EFFECT ON PRODUCTION:

___ WEATHER (RAIN)
___ TRAFFIC
___ INSUFFICIENT MANPOWER OR EQUIPMENT
___ UTILITY DELAYS
___ PHASING OF WORK REQUIRED BY CONTRACT
___ BURNING NOT ALLOWED
___ OTHER ______________________________
___ OTHER ______________________________

COLLEGE OF ENGINEERING

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DEPARTMENT OF CIVIL ENGINEERING

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FLORIDA DEPARTMENT OF TRANSPORTATION

FIELD OBSERVATIONS
(Please, see instructions on reverse side.)

WORK ACTIVITY: **EXCAVATION**

1. STATE PROJECT JOB NO.: ____________________
2. TOTAL QUANTITY OF WORK IN THE JOB: ______________ Cu. Yds.
3. OBSERVED PRODUCTION QUANTITIES:
   DATE: ________ QUANTITY: ________ Cu.Yds. NO. HOURS WORKED: ______
   DATE: ________ QUANTITY: ________ Cu.Yds. NO. HOURS WORKED: ______
   DATE: ________ QUANTITY: ________ Cu.Yds. NO. HOURS WORKED: ______
   DATE: ________ QUANTITY: ________ Cu.Yds. NO. HOURS WORKED: ______
   DATE: ________ QUANTITY: ________ Cu.Yds. NO. HOURS WORKED: ______
4. TYPE OF EXCAVATION WORK:
   ___ REGULAR
   ___ LATTERAL DITCH
   ___ SUBSOIL
5. TYPE OF MATERIAL
   ___ SAND
   ___ CLAY
   ___ ROCK
6. FACTORS WHICH HAD AN EFFECT ON PRODUCTION:
   ___ WEATHER (RAIN)
   ___ TRAFFIC
   ___ INSUFFICIENT MANPOWER OR EQUIPMENT
   ___ UTILITY DELAYS
   ___ PHASING OF WORK REQUIRED BY CONTRACT
   ___ OTHER ____________________
   ___ OTHER ____________________
7. FDOT PROJECT ENGINEER ____________________ DATE: __________

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(Please, see instructions on reverse side.)

WORK ACTIVITY: **STABILIZING**

1. STATE PROJECT JOB NO.: ______________________
2. TOTAL QUANTITY OF WORK IN THE JOB: ______________ Sq. Yds.
3. OBSERVED PRODUCTION QUANTITIES:

   DATE: ________ QUANTITY: ________ Sq.Yds. NO. HOURS WORKED: ______
   DATE: ________ QUANTITY: ________ Sq.Yds. NO. HOURS WORKED: ______
   DATE: ________ QUANTITY: ________ Sq.Yds. NO. HOURS WORKED: ______
   DATE: ________ QUANTITY: ________ Sq.Yds. NO. HOURS WORKED: ______
   DATE: ________ QUANTITY: ________ Sq.Yds. NO. HOURS WORKED: ______

4. FACTORS WHICH HAD AN EFFECT ON PRODUCTION:

   ___ WEATHER (RAIN)
   ___ TRAFFIC
   ___ INSUFFICIENT MANPOWER OR EQUIPMENT
   ___ UTILITY DELAYS
   ___ PHASING OF WORK REQUIRED BY CONTRACT
   ___ OTHER ______________________________
   ___ OTHER ______________________________

5. FDOT PROJECT ENGINEER ____________________ DATE: __________

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WORK ACTIVITY: **BASE CONSTRUCTION**

1. STATE PROJECT JOB NO.: ______________________
2. TOTAL QUANTITY OF WORK IN THE JOB: ______________ Sq. Yds.
3. OBSERVED PRODUCTION QUANTITIES:

DATE: ________ QUANTITY: ________ Sq.Yds. NO. HOURS WORKED: ______
DATE: ________ QUANTITY: ________ Sq.Yds. NO. HOURS WORKED: ______
DATE: ________ QUANTITY: ________ Sq.Yds. NO. HOURS WORKED: ______
DATE: ________ QUANTITY: ________ Sq.Yds. NO. HOURS WORKED: ______
DATE: ________ QUANTITY: ________ Sq.Yds. NO. HOURS WORKED: ______

4. TYPE OF MATERIAL
   ___ SAND CLAY
   ___ LIMEROCK
   ___ SHELL STABILIZED
   ___ SOIL CEMENT
   ___ ASPHALTIC BASE
5. FACTORS WHICH HAD AN EFFECT ON PRODUCTION:
   ___ WEATHER (RAIN)
   ___ TRAFFIC
   ___ INSUFFICIENT MANPOWER OR EQUIPMENT
   ___ UTILITY DELAYS
   ___ PHASING OF WORK REQUIRED BY CONTRACT
   ___ OTHER ______________________________
   ___ OTHER ______________________________
6. FDOT PROJECT ENGINEER ____________________ DATE: __________

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WORK ACTIVITY: **SURFACE TREATMENT**

1. STATE PROJECT JOB NO.: ____________________
2. TOTAL QUANTITY OF WORK IN THE JOB: ____________ Cu. Yds.
3. OBSERVED PRODUCTION QUANTITIES:

   DATE: ________ QUANTITY: ________ Cu.Yds. NO. HOURS WORKED: ______
   DATE: ________ QUANTITY: ________ Cu.Yds. NO. HOURS WORKED: ______
   DATE: ________ QUANTITY: ________ Cu.Yds. NO. HOURS WORKED: ______
   DATE: ________ QUANTITY: ________ Cu.Yds. NO. HOURS WORKED: ______
   DATE: ________ QUANTITY: ________ Cu.Yds. NO. HOURS WORKED: ______

4. FACTORS WHICH HAD AN EFFECT ON PRODUCTION:

   ___ WEATHER (RAIN)
   ___ TRAFFIC
   ___ INSUFFICIENT MANPOWER OR EQUIPMENT
   ___ UTILITY DELAYS
   ___ PHASING OF WORK REQUIRED BY CONTRACT
   ___ OTHER ______________________________
   ___ OTHER ______________________________

5. FDOT PROJECT ENGINEER ____________________ DATE: __________

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(Please, see instructions on reverse side.)

WORK ACTIVITY: **CONCRETE PAVEMENT**

1. STATE PROJECT JOB NO.: ______________________

2. TOTAL QUANTITY OF WORK IN THE JOB: ______________ Sq. Yds.

3. OBSERVED PRODUCTION QUANTITIES:

   DATE: ________ QUANTITY: ________ Sq.Yds. NO. HOURS WORKED: ______
   DATE: ________ QUANTITY: ________ Sq.Yds. NO. HOURS WORKED: ______
   DATE: ________ QUANTITY: ________ Sq.Yds. NO. HOURS WORKED: ______
   DATE: ________ QUANTITY: ________ Sq.Yds. NO. HOURS WORKED: ______
   DATE: ________ QUANTITY: ________ Sq.Yds. NO. HOURS WORKED: ______

4. THICKNESS OF THE PAVEMENT: ________ In.

5. FACTORS WHICH HAD AN EFFECT ON PRODUCTION:

   ___ WEATHER (RAIN)
   ___ TRAFFIC
   ___ INSUFFICIENT MANPOWER OR EQUIPMENT
   ___ UTILITY DELAYS
   ___ PHASING OF WORK REQUIRED BY CONTRACT
   ___ OTHER ______________________________
   ___ OTHER ______________________________

6. FDOT PROJECT ENGINEER ______________________ DATE: __________

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WORK ACTIVITY: **MILLING EXISTING PAVEMENT**

1. STATE PROJECT JOB NO.: ______________________________
2. TOTAL QUANTITY OF WORK IN THE JOB: ____________________ Sq. Yds.
3. OBSERVED PRODUCTION QUANTITIES:

   DATE: __________ QUANTITY: _________ Sq.Yds. NO. HOURS WORKED: _______
   DATE: __________ QUANTITY: _________ Sq.Yds. NO. HOURS WORKED: _______
   DATE: __________ QUANTITY: _________ Sq.Yds. NO. HOURS WORKED: _______
   DATE: __________ QUANTITY: _________ Sq.Yds. NO. HOURS WORKED: _______
   DATE: __________ QUANTITY: _________ Sq.Yds. NO. HOURS WORKED: _______

4. FACTORS WHICH HAD AN EFFECT ON PRODUCTION:

   ___ WEATHER (RAIN)
   ___ TRAFFIC
   ___ INSUFFICIENT MANPOWER OR EQUIPMENT
   ___ UTILITY DELAYS
   ___ PHASING OF WORK REQUIRED BY CONTRACT
   ___ OTHER ____
   ___ OTHER ____

5. FDOT PROJECT ENGINEER ______________________________ DATE: _____________

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(Please, see instructions on reverse side.)

WORK ACTIVITY: **PLANT MIX SURFACE** (STRUCTURAL COURSE)

1. STATE PROJECT JOB NO.: ______________________________
2. TOTAL QUANTITY OF WORK IN THE JOB: ___________________ Tons
3. OBSERVED PRODUCTION QUANTITIES

   DATE: __________ QUANTITY: _________ Tons NO. HOURS WORKED: _______
   DATE: __________ QUANTITY: _________ Tons NO. HOURS WORKED: _______
   DATE: __________ QUANTITY: _________ Tons NO. HOURS WORKED: _______
   DATE: __________ QUANTITY: _________ Tons NO. HOURS WORKED: _______
   DATE: __________ QUANTITY: _________ Tons NO. HOURS WORKED: _______

4. FACTORS WHICH HAD AN EFFECT ON PRODUCTION:

   ___ WEATHER (RAIN)
   ___ TRAFFIC
   ___ INSUFFICIENT MANPOWER OR EQUIPMENT
   ___ UTILITY DELAYS
   ___ PHASING OF WORK REQUIRED BY CONTRACT
   ___ OTHER ____
   ___ OTHER ____

5. FDOT PROJECT ENGINEER ______________________________ DATE: _____________

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FIELD OBSERVATIONS

(Please, see instructions on reverse side.)

WORK ACTIVITY: **STORM SEWERS**

1. STATE PROJECT JOB NO.: ______________________________

2. TOTAL QUANTITY OF WORK IN THE JOB: ____________________ L.F.

3. OBSERVED PRODUCTION QUANTITIES:

DATE:_______ QUANTITY:______L.F. AVE.DEPTH:_____Ft. AVE.DIA.:_____In. HRS. WORKED:_____
DATE:_______ QUANTITY:______L.F. AVE.DEPTH:_____Ft. AVE.DIA.:_____In. HRS. WORKED:_____
DATE:_______ QUANTITY:______L.F. AVE.DEPTH:_____Ft. AVE.DIA.:_____In. HRS. WORKED:_____
DATE:_______ QUANTITY:______L.F. AVE.DEPTH:_____Ft. AVE.DIA.:_____In. HRS. WORKED:_____
DATE:_______ QUANTITY:______L.F. AVE.DEPTH:_____Ft. AVE.DIA.:_____In. HRS. WORKED:_____

4. FACTORS WHICH HAD AN EFFECT ON PRODUCTION:

___ WEATHER (RAIN)
___ TRAFFIC
___ INSUFFICIENT MANPOWER OR EQUIPMENT
___ UTILITY DELAYS
___ PHASING OF WORK REQUIRED BY CONTRACT
___ OTHER ____
___ OTHER ____

5. FDOT PROJECT ENGINEER ______________________________ DATE: ______________

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WORK ACTIVITY: **CURB and GUTTER**

1. STATE PROJECT JOB NO.: ______________________________

2. TOTAL QUANTITY OF WORK IN THE JOB: ____________________ L.F.

3. OBSERVED PRODUCTION QUANTITIES:

   DATE: __________ QUANTITY: _________ L.F. NO. HOURS WORKED: _______
   DATE: __________ QUANTITY: _________ L.F. NO. HOURS WORKED: _______
   DATE: __________ QUANTITY: _________ L.F. NO. HOURS WORKED: _______
   DATE: __________ QUANTITY: _________ L.F. NO. HOURS WORKED: _______
   DATE: __________ QUANTITY: _________ L.F. NO. HOURS WORKED: _______

4. FACTORS WHICH HAD AN EFFECT ON PRODUCTION:

   ___ WEATHER (RAIN)
   ___ TRAFFIC
   ___ INSUFFICIENT MANPOWER OR EQUIPMENT
   ___ UTILITY DELAYS
   ___ PHASING OF WORK REQUIRED BY CONTRACT
   ___ OTHER ____
   ___ OTHER ____

5. FDOT PROJECT ENGINEER ______________________________ DATE: _____________

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WORK ACTIVITY: **SIDEWALK**

1. STATE PROJECT JOB NO.: ______________________________
2. TOTAL QUANTITY OF WORK IN THE JOB: ____________________ Sq. Yds.
3. OBSERVED PRODUCTION QUANTITIES:

   DATE: __________ QUANTITY: _________ Sq.Yds. NO. HOURS WORKED: _______
   DATE: __________ QUANTITY: _________ Sq.Yds. NO. HOURS WORKED: _______
   DATE: __________ QUANTITY: _________ Sq.Yds. NO. HOURS WORKED: _______
   DATE: __________ QUANTITY: _________ Sq.Yds. NO. HOURS WORKED: _______
   DATE: __________ QUANTITY: _________ Sq.Yds. NO. HOURS WORKED: _______

4.. FACTORS WHICH HAD AN EFFECT ON PRODUCTION:

   ___ WEATHER (RAIN)
   ___ TRAFFIC
   ___ INSUFFICIENT MANPOWER OR EQUIPMENT
   ___ UTILITY DELAYS
   ___ PHASING OF WORK REQUIRED BY CONTRACT
   ___ OTHER ____
   ___ OTHER ____

5. FDOT PROJECT ENGINEER ______________________________ DATE: _____________

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(Please, see instructions on reverse side.)

WORK ACTIVITY: **SEED and MULCH**

1. STATE PROJECT JOB NO.: ______________________
2. TOTAL QUANTITY OF WORK IN THE JOB: ______________ Sq. Yds.
3. OBSERVED PRODUCTION QUANTITIES:

   DATE: ________ QUANTITY: ________ Sq.Yds. NO. HOURS WORKED: ______
   DATE: ________ QUANTITY: ________ Sq.Yds. NO. HOURS WORKED: ______
   DATE: ________ QUANTITY: ________ Sq.Yds. NO. HOURS WORKED: ______
   DATE: ________ QUANTITY: ________ Sq.Yds. NO. HOURS WORKED: ______
   DATE: ________ QUANTITY: ________ Sq.Yds. NO. HOURS WORKED: ______

4. FACTORS WHICH HAD AN EFFECT ON PRODUCTION:

   ___ WEATHER (RAIN)
   ___ TRAFFIC
   ___ INSUFFICIENT MANPOWER OR EQUIPMENT
   ___ UTILITY DELAYS
   ___ PHASING OF WORK REQUIRED BY CONTRACT
   ___ OTHER ______________________________
   ___ OTHER ______________________________

5. FDOT PROJECT ENGINEER ______________________ DATE: __________

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University of Florida

Gainesville, Florida 32611
Area Code 904 Phone 392-0933

Department of Civil Engineering

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(Please, see instructions on reverse side.)

WORK ACTIVITY: **SOD**

1. STATE PROJECT JOB NO.: ____________________

2. TOTAL QUANTITY OF WORK IN THE JOB: ____________ Sq. Yds.

3. OBSERVED PRODUCTION QUANTITIES:

   DATE: ________ QUANTITY: ________ Sq.Yds. NO. HOURS WORKED: ______
   DATE: ________ QUANTITY: ________ Sq.Yds. NO. HOURS WORKED: ______
   DATE: ________ QUANTITY: ________ Sq.Yds. NO. HOURS WORKED: ______
   DATE: ________ QUANTITY: ________ Sq.Yds. NO. HOURS WORKED: ______
   DATE: ________ QUANTITY: ________ Sq.Yds. NO. HOURS WORKED: ______

4. FACTORS WHICH HAD AN EFFECT ON PRODUCTION:

   ___ WEATHER (RAIN)
   ___ TRAFFIC
   ___ INSUFFICIENT MANPOWER OR EQUIPMENT
   ___ UTILITY DELAYS
   ___ PHASING OF WORK REQUIRED BY CONTRACT
   ___ OTHER ____________________
   ___ OTHER ____________________

5. FDOT PROJECT ENGINEER ____________________ DATE: __________

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(Please, see instructions on reverse side.)

WORK ACTIVITY: **GUARDRAIL**

1. STATE PROJECT JOB NO.: ____________________

2. TOTAL QUANTITY OF WORK IN THE JOB: ______________ L.F.

3. OBSERVED PRODUCTION QUANTITIES:

   DATE: ________ QUANTITY: ________ L.F. NO. HOURS WORKED: ______
   DATE: ________ QUANTITY: ________ L.F. NO. HOURS WORKED: ______
   DATE: ________ QUANTITY: ________ L.F. NO. HOURS WORKED: ______
   DATE: ________ QUANTITY: ________ L.F. NO. HOURS WORKED: ______
   DATE: ________ QUANTITY: ________ L.F. NO. HOURS WORKED: ______

4. FACTORS WHICH HAD AN EFFECT ON PRODUCTION:

   ___ WEATHER (RAIN)
   ___ TRAFFIC
   ___ INSUFFICIENT MANPOWER OR EQUIPMENT
   ___ UTILITY DELAYS
   ___ PHASING OF WORK REQUIRED BY CONTRACT
   ___ OTHER ______________________________
   ___ OTHER ______________________________

5. FDOT PROJECT ENGINEER ____________________ DATE: __________

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WORK ACTIVITY: **REFLECTIVE PAVEMENT MARKERS**

1. STATE PROJECT JOB NO.: ______________________
2. TOTAL QUANTITY OF WORK IN THE JOB: ______________ Each.
3. OBSERVED PRODUCTION QUANTITIES

DATE: ________ QUANTITY: ________ Each NO. HOURS WORKED: ______
DATE: ________ QUANTITY: ________ Each NO. HOURS WORKED: ______
DATE: ________ QUANTITY: ________ Each NO. HOURS WORKED: ______
DATE: ________ QUANTITY: ________ Each NO. HOURS WORKED: ______
DATE: ________ QUANTITY: ________ Each NO. HOURS WORKED: ______

4. FACTORS WHICH HAD AN EFFECT ON PRODUCTION:

___ WEATHER (RAIN)
___ TRAFFIC
___ INSUFFICIENT MANPOWER OR EQUIPMENT
___ UTILITY DELAYS
___ PHASING OF WORK REQUIRED BY CONTRACT
___ OTHER ______________________________
___ OTHER ______________________________

5. FDOT PROJECT ENGINEER ______________________ DATE: ____________

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WORK ACTIVITY: **BREAKING AND COMPACTING EXISTING CONCRETE**

1. STATE PROJECT JOB NO.: ______________________

2. TOTAL QUANTITY OF WORK IN THE JOB: ______________ Sq. Yds.

3. OBSERVED PRODUCTION QUANTITIES:

   DATE: ________ QUANTITY: ________ Sq.Yds. NO. HOURS WORKED: ______
   DATE: ________ QUANTITY: ________ Sq.Yds. NO. HOURS WORKED: ______
   DATE: ________ QUANTITY: ________ Sq.Yds. NO. HOURS WORKED: ______
   DATE: ________ QUANTITY: ________ Sq.Yds. NO. HOURS WORKED: ______
   DATE: ________ QUANTITY: ________ Sq.Yds. NO. HOURS WORKED: ______

4. FACTORS WHICH HAD AN EFFECT ON PRODUCTION:

   ___ WEATHER (RAIN)
   ___ TRAFFIC
   ___ INSUFFICIENT MANPOWER OR EQUIPMENT
   ___ UTILITY DELAYS
   ___ PHASING OF WORK REQUIRED BY CONTRACT
   ___ OTHER ______________________________
   ___ OTHER ______________________________

5. FDOT PROJECT ENGINEER ______________________ DATE: __________

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WORK ACTIVITY: **COMPRESSION SEAL REPLACEMENT**

1. STATE PROJECT JOB NO.: ____________________
2. TOTAL QUANTITY OF WORK IN THE JOB: ______________ L.F.
3. OBSERVED PRODUCTION QUANTITIES:

   DATE: ________ QUANTITY: ________ L.F. NO. HOURS WORKED: ______
   DATE: ________ QUANTITY: ________ L.F. NO. HOURS WORKED: ______
   DATE: ________ QUANTITY: ________ L.F. NO. HOURS WORKED: ______
   DATE: ________ QUANTITY: ________ L.F. NO. HOURS WORKED: ______
   DATE: ________ QUANTITY: ________ L.F. NO. HOURS WORKED: ______

4. FACTORS WHICH HAD AN EFFECT ON PRODUCTION:

   ___ WEATHER (RAIN)
   ___ TRAFFIC
   ___ INSUFFICIENT MANPOWER OR EQUIPMENT
   ___ UTILITY DELAYS
   ___ PHASING OF WORK REQUIRED BY CONTRACT
   ___ OTHER ______________________________
   ___ OTHER ______________________________

5. FDOT PROJECT ENGINEER ____________________ DATE: __________

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